Engineering Study

NH Route 25/Fox Hollow Road Intersection

Moultonborough, New Hampshire

KV Partners
CONSULTING ENGINEERS

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October 2009

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SECTION 1 – INTRODUCTION AND BACKGROUND

1.1 Purpose of Study

In 2006, the Lakes Region Planning Commission (LRPC) identified the NH Route 25 corridor as a regional priority for study, and in April 2008 completed the *NH Route 25 Corridor Study*. NH Route 25 "…serves as a primary east-west connection for trucking between Maine and Central New Hampshire, and is a significant connection between Interstate 93 and the eastern Lakes Region communities." The intent of this corridor study was to "...assess current conditions, identify potential safety improvements, assess potential future traffic demand based on development potential, and outline practical land use and access management strategies that can be implemented at the local level and in coordination with appropriate agencies".

The Town of Moultonborough is seeking to complete roadway improvements in NH Route 25 at the intersection with Fox Hollow Road. These improvements are to address safety issues created by the impaired visibility of the intersection and difficult turning movements into and out of Fox Hollow Road. The purpose of this Engineering Study is to establish design criteria, assess impacts to adjoining properties and natural and archaeological resources, analyze alternative solutions for roadway improvements and select a preferred alternative.

1.2 Scope of Study

The NH Route 25/Fox Hollow Road Intersection Project is being completed in partnership with the New Hampshire Department of Transportation (NHDOT) under the Municipally-Managed State Aid Highway Program (SAH) and the Municipally-Managed Federal Aid Surface Transportation Program (STP). The project has been authorized to receive state and federal funding under these programs. The scope of this study is intended to meet the requirements set forth under those programs. In summary, this report includes:

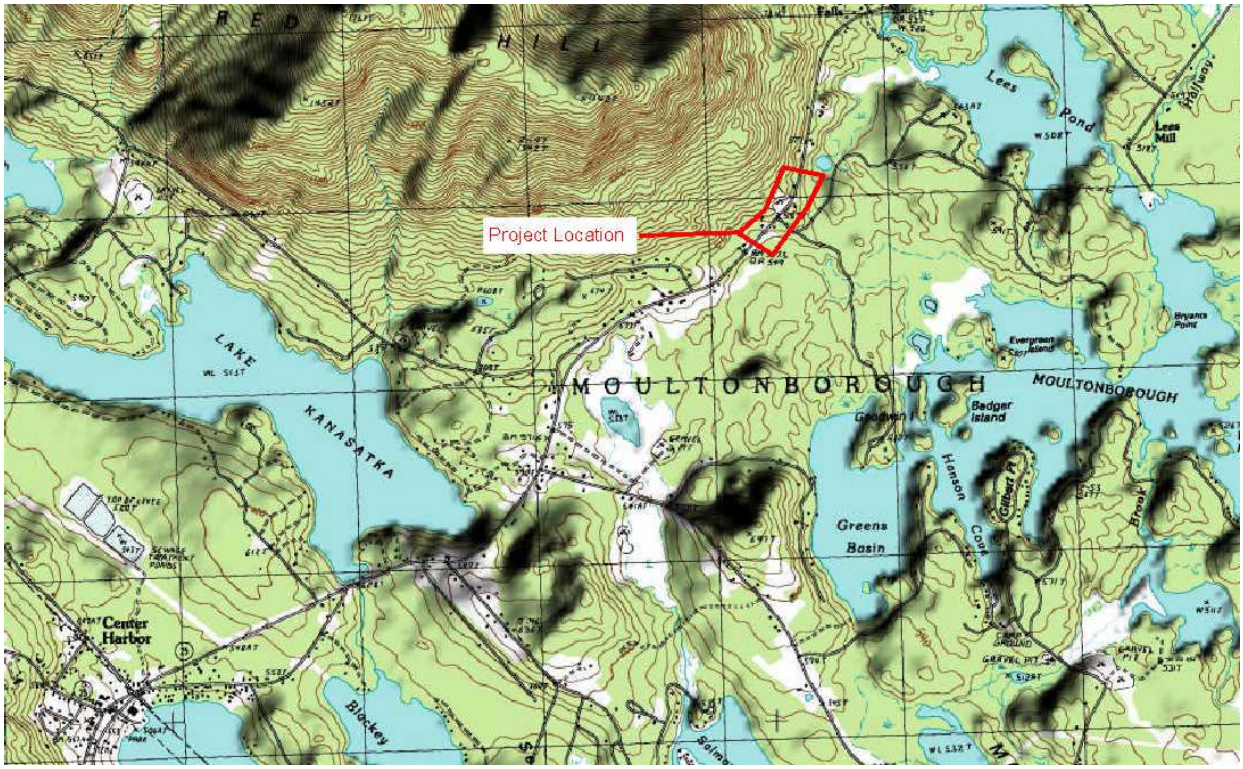
- Description of Project Area
- Description of Existing Conditions
- Rationale on the Need for the Project
- Alternatives Analysis

- Selection of Alternative
- Description of the Proposed Project

1.3 Project Location

The project is located in the Town of Moultonborough and includes a segment of NH Route 25 (approximately 1,500 feet) and adjoining segment of Fox Hollow Road (approximately 120 feet). This "T" intersection is located approximately 1.25 miles east of the signalized intersection of Moultonborough Neck Road. The area is dominated by residential properties. Refer to Figure 1 for a location of the project.

Figure 1
Location Plan



1.4 Existing Conditions

NH Route 25 is a state owned and maintained two lane road traversing the north side of Lake Winnipesaukee. Fox Hollow Road is a town owned and maintained road (approximately 500

feet) intersecting NH Route 25. Fox Hollow Road provides the sole public access and egress for approximately 75 homes along Fox Hollow Road, Gilman Point Road, Acorn Lane, Moose Walk, and other roads. Most of the development in this neighborhood consists of single family homes located along the waterfront of Lake Winnipesaukee and Lee's Pond. Several larger, interior parcels remain undeveloped at this time. Additional development in this neighborhood is likely given the proximity to the aforementioned lakes.

The intersection of NH Route 25/Fox Hollow Road is a "T"-intersection controlled by a stop sign on Fox Hollow Road northbound. In the area of the intersection, the posted speed limit on NH Route 25 is 45 miles per hour. At the intersection, NH Route 25 is 26 feet wide both east and west of Fox Hollow Road with a soft shoulder on the north side and a gravel swale on the south side. Combination curve/intersection ahead signs are located on both the eastbound and westbound approaches of NH Route 25 approximately 450-500 feet in advance of the intersection.

Fox Hollow Road intersects NH Route 25 just west of a horizontal curve and just east of the crest of a vertical curve. Fox Hollow Road is narrow, only 17-18 feet wide at a point just 30 feet south of the edge of the NH Route 25 travelway. NH Route 25 is in a cut section with earthen embankments close to both sides of NH Route 25 in the vicinity of the intersection. Both sides of Fox Hollow Road are heavily wooded.

1.5 Need for Project

The principal deficiency at the NH Route 25/Fox Hollow Road intersection is the limited sight distance traveling westbound along NH Route 25 and the difficult turning movements into and out of Fox Hollow Road. Key issues include:

1. The Fox Hollow Road intersection is located approximately 315' west of the crest of a vertical curve on NH Route 25. The existing posted speed limit on NH Route 25 at this location is 45 miles per hour. Left turn movements from Fox Hollow Road onto westbound NH Route 25 are problematic due to the limited intersection sight distance caused by the vertical curve and speed of westbound NH Route 25 vehicles. Vehicles entering from Fox Hollow Road do not have adequate time to determine if they can safely enter onto NH Route 25. This problem is exacerbated by the fact that some vehicles "bottom-out" at the

paved drainage swale located at the intersection with NH Route 25 as they move from Fox Hollow to NH Route 25, thereby slowing their progression onto NH Route 25.

2. Vehicles heading westbound on NH Route 25 have limited sight distance around the combination horizontal and vertical curve as they approach the Fox Hollow Road intersection. Vehicles queued for a left turn movement onto Fox Hollow Road are obstructed from oncoming westbound vehicles and are highly susceptible to rear end collisions.

3. Due to the tight turning radii, vehicles traveling eastbound on NH Route 25 and making right turn movements onto Fox Hollow Road must slow down considerably to complete the turn to navigate the narrow entrance to Fox Hollow Road. This is particularly problematic if there is another vehicle standing at the stop condition on Fox Hollow Road waiting to turn on to NH Route 25. Deceleration in NH Route 25 eastbound from this movement causes vehicles to queue on NH Route 25 and leaves the turning vehicle susceptible to a rear end collision. Eastbound NH Route 25 vehicles cannot safely maneuver around a right-turning vehicle entering Fox Hollow Road due to the limited sight distance created by the combination horizontal and vertical curves.

4. As a lakefront neighborhood, the Fox Hollow Road/Gilman Point Road neighborhood is a desirable location and is likely to experience substantial development in the future. The buildout projections completed under the traffic analysis completed for this study predicts traffic volumes entering and exiting Fox Hollow Road will be twice the volumes in 2029 as compared with 2009. An increase in traffic volume will only make the current deficiencies at the intersection more problematic over time.

5. The NHDOT, District 3 Office has identified frequent washouts at the private drive located on the south side of NH Route 25 immediately west of the Fox Hollow Road intersection. Consideration should be given to alleviating this condition.

SECTION 2 – ANALYSIS

2.1 General

As stated, the purpose of this Engineering Study is to establish design criteria, assess impacts to adjoining properties and natural and archaeological resources, analyze alternative solutions for roadway improvements and select a preferred alternative. The preferred alternative should meet the following objectives:

1. **Improve safety and operations:** As stated, the primary goal of this project is to improve vehicular and pedestrian safety at the NH Route 25/Fox Hollow Road intersection. In addition, there are other enhancements to consider that will determine the overall footprint of the project. These include: side slope impacts; a possible westbound left turn lane; widened shoulders; improvements to better facilitate snow removal operations in Fox Hollow Road; drainage improvements; and mitigation of existing drainage issues identified by the NHDOT. The key here will be to achieve these objectives while minimizing impacts to adjacent properties and utilities, minimize construction costs and better ensure construction proceeds in a safe, efficient and appropriate manner.

2. **Minimize impacts to adjoining property, utilities and requirements for land acquisitions and easements.** It is probable that work will be required outside the NHDOT right-of-way. It is important to minimize this work to address property owners concerns, ensure the project stays on schedule and to minimize potential costs associated with utility pole relocations, side slope improvements and land acquisitions/easements.

3. **Minimize impacts to natural and archeological resources potentially impacted by construction activity.** There is the potential that work will impact wetland areas. It is important to minimize potential impacts to these and other identified natural resource areas. An evaluation will need to be completed to determine if any archeological resources exist within the project limits.

4. **Minimize construction and long-term maintenance costs.** According to the NHDOT, the Town is eligible for 100% reimbursement for all construction costs based on the latest construction cost estimate of $599,622. The Town and NHDOT will share the costs for engineering and project development at 33% and 67% respectively. Costs for that portion of the reconstruction of Fox Hollow not related to the construction of NH Route 25 will be fully borne by the Town. The Town has committed $199,874 to the project as per their State Highway Aid Application dated March 19, 2009. The Town wishes to stay within the total budgetary limits ($799,496) set for the project. In addition, the NHDOT, District 3 office seeks to minimize long-term maintenance costs within the corridor.

5. **Minimize impacts to the traveling public through the work zone during construction.** As stated, the NH Route 25 corridor is defined in the regional transportation plan as a "lifeline corridor" and serves as a "primary east-west connection" for the state. Traffic volumes will be significant during construction and delays will affect area residents and businesses, the traveling public and pedestrians and bicyclists that use the corridor. Performance requirements during construction that need to be addressed include: maintenance of traffic through the work zone during working and non-working hours; ready access/egress from Fox Hollow Road; unlimited access by emergency response vehicles; access to private properties within the work area; and pedestrian/cyclist safety.

6. **Minimize construction nuisance:** It is important to ensure area resident concerns are promptly addressed and impacts mitigated during construction. This includes: requiring strict construction site maintenance and housekeeping; maintaining utility services; noise abatement; ensuring a reasonable daily work schedule; controlling haul routes and access/egress of construction vehicles to the job site; and identifying suitable off-site stockpile/staging areas.

7. **Maintain the rural character:** While it is imperative that the safety issues be addressed, it is also important to the Town that that the final outcome reflects and respects the rural character of the area.

2.2 Traffic Analysis

A traffic analysis was completed at the NH Route 25/Fox Hollow Road intersection. In summary, the scope of work included: field reconnaissance to assess existing conditions; traffic counts; vehicle speed studies; accident history research; auxiliary turn lane warrant analysis; traffic signal warrant analysis; and capacity analysis for the intersection. The results of the analysis are summarized below. For additional details, refer to the report entitled *Traffic Analysis Route 25/Fox Hollow Road, Moultonborough; dated August 17, 2009* presented in Appendix A.

1. A left turn lane should be constructed on NH Route 25 westbound at Fox Hollow Road.
    - Heavy through traffic volumes on NH Route 25 combined with high vehicle speeds create a low threshold for meeting the left turn lane warrants. Despite relatively low left turn volumes from NH Route 25 into Fox Hollow Road, left turn lane warrants were met considering 2009 and 2029 peak hour volumes.
    - Turning volumes at Fox Hollow Road were based on one day of counts during a typical weekday and Saturday in the summer. Left turn lane warrants were met based on these typical conditions. Since left turn volumes may be higher on Friday evenings and holiday weekends, provision of a left turn lane would accommodate peak conditions as well.
    - A left turn lane will move left turning vehicles from the westbound lane, reducing delays for through vehicles and reducing the potential for rear end collisions.
    - Limited sight distance around the horizontal curve on NH Route 25 is a contributing safety factor when considering the need for a left turn lane.
    - If a left turn lane cannot be provided due to physical, environmental or fiscal constraints, a bypass shoulder should be constructed, at a minimum.

2. A right turn taper should be constructed on NH Route 25 eastbound at Fox Hollow Road.
    - As mentioned above for the left turns, heavy through traffic volumes on NH Route 25 combined with high vehicle speeds create a low threshold for meeting the right turn lane warrants. A right turn taper was found to be warranted based on the right turn volume.

- A right turn taper will move right turning vehicles from the eastbound lane more quickly, resulting in less delays to through vehicles and reducing the potential for rear end collisions.

3. The width of Fox Hollow Road near NH Route 25 should be increased to at least 22 feet wide.

   - Provision of adequate turning radii and an adequate width on Fox Hollow Road will allow vehicles to enter and exit from NH Route 25 more safely. The difference in speed between through vehicles and turning vehicles is a safety issue.

4. Adequate stopping sight distance and intersection sight distance based on the observed 85th percentile speeds along NH Route 25 should be provided if possible.

   - The posted speed limit is 45 miles per hour, however, road design is typically based on the 85th percentile speed. Provision of sight distance requirements at the 85th percentile speed (observed at 55 mph) should improve safety at the intersection.

2.3 Existing Conditions Survey

Existing conditions surveys were completed to establish baseline information on which to complete the design of roadway improvements. A description of those surveys are provided below.

2.3.1 Engineering Survey

A detail survey of the respective roadway corridors was completed to obtain topographic information, identify the approximate limit of existing right-of-way, locate surface features and establish construction benchmarks and baseline. The limits of survey on NH Route 25 extend from approximately 800 feet east to 1,000 feet west of the Fox Hollow Road intersection. The lateral limits in this corridor extend 50 to 100 feet from the existing edges of pavement. The limits of survey on Fox Hollow Road extend from NH Route 25 to Gilman Point Road. The lateral limits in this corridor extend approximately 100 feet from the existing edges of pavement. The vertical datum is based on NAVD88 and was established using NHDOT Geodetic Control. The horizontal datum is based on NAD83 and is tied to the NH State Plane Coordinate System. For an existing conditions plan, refer to Figure 2.

2.3.2 Subsurface Investigations

A boring program will be completed upon direction on the selected alternative to determine the general nature of subsurface conditions within the respective corridors. Boring logs will be submitted under separate cover.

2.4 Environmental Considerations

As required by state and federal funding and regulatory agencies, the project must comply with applicable environmental laws, rules, regulations, and guidelines regarding, but not necessarily limited to, RSA 482-A (NH Fill and Dredge in Wetlands Act), RSA 227-C:9 (Directive for Cooperation in the Protection of Historic Resources), and Section 404 of the Clean Water Act (Federal Dredge and Fill Permit). Based on the work completed to date, the following environmental considerations have been identified.

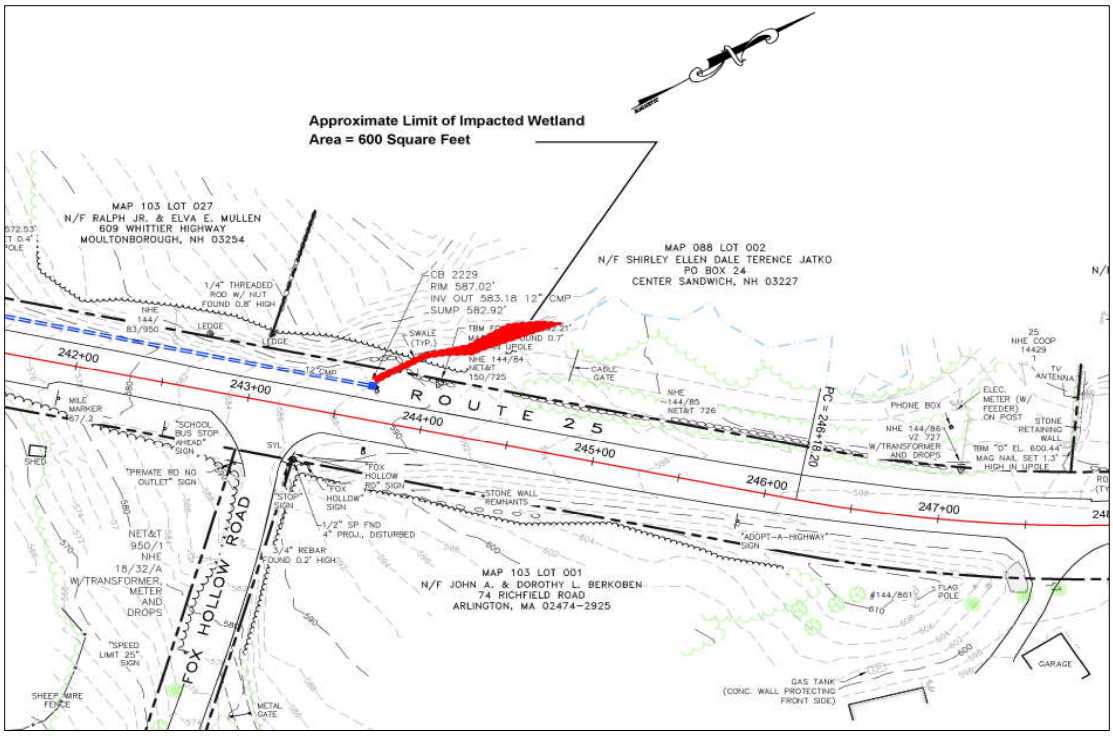
2.4.1 Historical/Archaeological Resources

Representatives of the Town and KVPartners will attend the NHDOT Cultural Resources Meeting. This meeting is a joint meeting with the NHDOT, the Division of Historical Resources (NHDHR), Federal Highway Administration (FHWA), and the US Army Corps of Engineers (ACOE) to identify potential historical or archaeological resources in the project area. Based on the limits of work anticipated for the project and visual inspection of the area, it is expected that there will be no significant impacts to historical or archeological resources.

2.4.2 Wetland Resources

Wetland resources are located in the project area. The identification and delineation of these resources was completed by a certified soil scientist and located in the field by a licensed land surveyor (Promised Land Survey, Londonderry, NH). Refer to Figure 3, for the location of wetlands potentially impacted by construction activity. Based on our review of the impacts, it is expected that a Minimum Impact Expedited Application will be required.

Figure 3
Wetland Areas Subject to Impact



2.5 Alternatives Analysis and Selection of Alternative

The following outlines the preliminary analysis completed for project selection. The analysis is based on available design documents, engineering studies and reports, survey completed within the project limits, interviews with Town and NHDOT staff, and field reconnaissance.

2.5.1 Previous Studies

As stated, in April 2008 the LRPC completed the *NH Route 25 Corridor Study*. In their report the LRPC identified several alternative solutions to address the safety concerns at the NH Route 25/Fox Hollow Road intersection. The alternatives discussed in the report included:

1. Raise and level the approach of Fox Hollow Road onto NH Route 25 to ease turning movements into and out of Fox Hollow Road.

2. Install a crash avoidance system to provide advanced warning of traffic conditions at the intersection.

3. Install a westbound turn lane or by-pass lane on NH Route 25.

4. Install overhead street name and warnings signs on NH Route 25 to warn oncoming traffic of the intersection location and potential slow moving traffic.

While cost estimates were developed for the alternatives, no firm recommendations were offered for a selected project. For additional details of the analysis, refer to Appendix B for excerpts from the *NH Route 25 Corridor Study*.

In January 2008, the Town completed a study on several alternatives to address the safety concerns at the NH Route 25/Fox Hollow Road intersection. The alternatives analyzed included:

1. Install intersection warning signs.

2. Lower the posted speed limit.

3. Install overhead flashing beacon.

4. Improve sight distance by lowering the embankment grade at the southeast corner of the intersection.

5. Construct a westbound by-pass shoulder

6. Construct a left turn lane for westbound vehicles.

7. Improve sight distance by reconstructing/re-grading NH Route 25.

8. Relocate the intersection to the west.

9. Relocate the intersection to the east.

10. Realign Fox Hollow Road to intersect with NH Route 25 in vicinity of the NHDOT Maintenance Facility.

Based on the results of the analysis, the Town selected Alternatives 7 and 10 for more detailed evaluation. Alternative 10 was subsequently eliminated from further consideration due to the extensive property impacts and land acquisition requirements. For additional details on this analysis, refer to Appendix C for the report entitled *Fox Hollow Road Intersection Engineering Study; dated January 4, 2008*.

2.5.2 Design Criteria

Design criteria for roadway reconstruction are based on the American Association of State Highway and Transportation Officials (AASHTO) policy and the New Hampshire Department of Transportation Highway Design Manual. The design criteria utilized for this analysis are the existing design speed (45 MPH) and the 85th percentile speed (55 MPH) as reported in the traffic analysis. The criteria are as follws:

Item	Criteria	
	45 MPH	**55 MPH**
Maximum Grade	7%	6%
Superelevation	8% max	8% max
Travel Lane Width	11 feet	11 feet
Turning Lane Width	12 feet	12 feet
Shoulder Width	4 feet	4 feet
Stopping Sight Distance	360 feet	495 feet
Level of Service	See Note 1	See Note 1

Notes:

1. For level of service information, refer to Page 10-11, Traffic Analysis-Route 25/Fox Hollow Road in Appendix A

Storm drainage systems will be designed for the 25-year storm event and checked against the 50-year storm event for potential impacts. Storm drainage structures (swales, culverts, catch basins, drain manholes, headwalls, outlet protection, etc.) will be designed in accordance with the New Hampshire Department of Transportation Highway Design Manual.

The existing horizontal and vertical geometries for NH Route 25 and Fox Hollow Road will be maintained to the maximum extent possible to minimize impacts to adjoining properties and the costs associated with utility relocation, site restoration, natural resource impact mitigation, and land acquisition, takings and easements. That said, to meet project objectives (refer to Section 2.1), the existing horizontal geometries will be most affected by requirements for pavement widening, stopping sight distance and design speed, while the existing vertical geometries will be most affected by the requirements to improve intersection site distance and access onto NH Route 25.

All material and construction requirements to be specified in the contract documents will meet the latest edition of the NHDOT Standard Specifications for Road and Bridge Construction.

2.5.3 Alternative Roadway Improvements

Based on work completed to date, KVPartners analyzed the following roadway improvement alternatives under the design criteria specified in Section 2.5.2. The alternatives were selected to meet the objectives as specified in Section 2.1. As stated, the major deficiency is the limited sight distance that westbound vehicles have around the combination horizontal and vertical curve as they approach the Fox Hollow Road intersection. Vehicles queued for a left turn movement onto Fox Hollow Road are obstructed from approaching traffic and are susceptible to rear end collisions. In addition, left turn movements from Fox Hollow Road onto westbound NH Route 25 are problematic due to the limited intersection sight distance caused by the vertical curve and speed of oncoming vehicles; vehicles entering from Fox Hollow Road do not have adequate time to determine if they can safely enter onto NH Route 25.

Alternative 1 - 45 MPH Design Speed:

An evaluation was completed on appropriate improvements at the current 45 MPH design speed. At this design speed, the existing vertical profile meets the 45 MPH criteria and can be maintained. As recommended in the traffic analysis, a left westbound turn lane and right turn taper at Fox Hollow Road are provided to address the safety issues noted above. The typical section at the Fox Hollow Road intersection would include (2) 11-foot travelways, (1) 12-foot left turn lane, and 4-foot wide shoulders for a total pavement footprint of 42 feet (refer to Figure 4). The existing pavement footprint is 26 feet. This will require the reconstruction of approximately 1500 feet of roadway to facilitate the proper taper from the new widened section to the existing

roadway width at the project limits. It is important to note that the horizontal curvature of NH Route 25, existing earthen embankments and residential buildings on the north side of NH Route 25 prevent the attainment of the required stopping sight distance without significant impacts to abutting properties.

Major items of construction will include: clearing, grubbing and removal of trees; installation of temporary bypass lane; reclaim of existing pavement; excavation of sideslope areas to accommodate the widening; removal and rehandling of reclaim material; installation of aggregate base course materials; re-grading of subbase and reestablishment of superelevated section; reconstruction of side slopes through the cut section; re-grading private drives; relocation of utility poles, signs, etc.; removal of existing drainage structures and installation of new drainage system; placement of pavement and pavement markings; and site restoration. Improvements at Fox Hollow road will include a widening to accommodate the eastbound right turn taper and to open the entrance to NH Route 25 to improve sight distance. Critical design and construction requirements include: maintenance of traffic during construction; minimizing construction nuisance issues (dust, noise, etc.) for area residents; and acquisition of temporary construction and permanent maintenance easements. Refer to Figure 4 for the typical section alternatives. Refer to Figure P-45 and PR-45 for the proposed alignment and profile respectively.

Alternative 2 - 55 MPH Design Speed:

A similar evaluation was completed at the 55 MPH design speed. The typical section was maintained as that for the 45 MPH design speed and impacts evaluated. In summary, to meet the 55 MPH design speed requires the lowering of the vertical profile for approximately 1000 feet across the entire westbound approach curve to a maximum cut of 6.4 feet. Lowering the roadway to this elevation has significant impacts on the two northerly properties (Map 88, Lots 3 and 4) and will most likely require the acquisition of Lot 3 and possibly Lot 4. As previously stated, the horizontal curvature of NH Route 25, existing earthen embankments and residential buildings on the north side of NH Route 25 prevent the attainment of the required stopping sight distance without significant impacts to abutting properties. The 55 MPH design speed will require the reconstruction of approximately 1800 feet of roadway to facilitate the proper taper from the new widened section to the existing roadway width at the project limits.

Major items of construction will include: clearing, grubbing and removal of trees; temporary pavement for bypass lane; reclaim of existing pavement; excavation of sideslope areas to accommodate the widening; removal and rehandling of reclaim material; excavation of aggregate base and subbase and subgrade materials; re-grading of subgrade and establishment of a new superelevated section; reconstruction of side slopes through the cut section; re-grading private drives; relocation of utility poles and other surface features; installation of new aggregate base course; removal of existing drainage structures and installation of new drainage system; placement of pavement and pavement markings; and site restoration. Improvements at Fox Hollow road will include those as specified for the 45 MPH design speed. Critical design and construction requirements include: maintenance of traffic during construction; minimizing construction nuisance issues (dust, noise, etc.) for area residents; and acquisition of temporary construction and permanent maintenance easements. Refer to Figure 4 for the alternative typical sections. Refer to Figure P-55 and PR-55 for the proposed alignment and vertical profile respectively.

Alternative 3 - No-Build:

As stated, the safety issues identified above will not be adequately addressed without some improvement to the NH Route 25/Fox Hollow Road intersection. These issues will only be more problematic over time as traffic volumes increase through the corridor as projected in the traffic analysis. The no-build alternative is not a viable option if the Town wishes to address the safety issues identified in this and previous studies.

Alternative 4 - Low-Build:

A fourth alternative includes improvements to Fox Hollow Road only. This would include: a widening of the intersection on Fox Hollow Road; construction of eastbound right turn taper in NH Route 25; excavation/regrading of side slopes on Fox Hollow to improve sight lines, vertical profile adjustments to better match grade elevations with NH Route 25; and replacement of the paved drainage swale at the intersection with a catch basin and cross culvert. This alternative provides limited improvement of access/egress to and from Fox Hollow Road when compared to Alternatives 1 and 2, and it does not address the key safety issue surrounding left turn movements of westbound traffic from NH Route 25 to Fox Hollow Road. This alternative may be considered if the other alternatives are deemed unacceptable due to property impacts or fiscal constraints.

2.6 Cost Estimate

Tables 2.1 through 2.3 present our opinion of probable project costs for the NH Route 25/Fox Hollow Road Intersection Project for the 45 and 55 MPH design speeds. Estimates are provided for two options under the 45 MPH design speed criteria for a) reclaim and widening (refer to Table 2.1) and b) widening and overlay (refer to Table 2.2.). For a typical section of each of these options refer to Figure 4.

The cost estimates include the cost of construction and professional services. The estimates do not include costs associated with land acquisitions/easements, debt retirement or inflation. The cost estimates are preliminary, subject to final design development, and are intended for planning purposes only. The construction costs are based on capital costs which include all major items of construction and are determined on a unit price basis based on recent bid prices for similar types of work. The unit price for each item includes all labor, materials, and equipment for construction. Quantity estimates are based on conceptual design layouts. A contingency factor of 10 percent is included to reflect the preliminary nature of the information used to prepare the estimates.

2.7 Conclusion and Proposed Project

Further discussions will be required with the Town and NHDOT representatives to select a preferred alternative. However, based on the constraints and issues identified above, the 45 MPH design speed appears to offer the best balance of addressing the key safety issues while minimizing impacts and costs.

Table 2.1
Preliminary Opinion of Probable Project Costs
45 MPH Design Speed: Reclaim and Widen

DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	COST
Mobilization	1	LS	$35,000.00	$35,000
Clearing and Grubbing	1.6	AC	$5,000.00	$8,000
Utility Pole Relocation	7	EA	$2,500.00	$17,500
Large Tree Removal	6	EA	$800.00	$4,800
Exploratory Excavation	50	CY	$30.00	$1,500
Rock Excavation	50	CY	$200.00	$10,000
Excavation of Unsuitable Material	300	CY	$15.00	$4,500
Common Excavation	5700	CY	$10.00	$57,000
Embankment In-Place	470	CY	$4.00	$1,880
15" HDPE Drain Pipe	1400	LF	$35.00	$49,000
15" End Sections	3	EA	$140.00	$420
Catch Basin	7	EA	$2,500.00	$17,500
Sloped Granite Curb	1500	LF	$20.00	$30,000
Gravel	470	CY	$20.00	$9,400
Crushed Gravel	650	CY	$25.00	$16,250
Class C Stone	110	CY	$35.00	$3,850
Reclaimed Stabilized Base	4570	SY	$3.00	$13,710
Remove & Rehandle Reclaimed Stabilized Base	4570	SY	$4.00	$18,280
HBP Temporary Pavement	300	TN	$80.00	$24,000
3" HBP Base Course	1160	TN	$90.00	$104,400
2" HBP Binder Course	830	TN	$90.00	$74,700
1" HBP Wearing Course	420	TN	$90.00	$37,800
HBP Hand Method	80	TN	$140.00	$11,200
Reflective Paint Pavement Marking 4" Line	3000	LF	$0.20	$600
Reflective Paint Pavement Marking 12" Line	6000	LF	$0.25	$1,500
Remove Gaurdrail	900	LF	$2.50	$2,250
Gaurdrail	900	LF	$30.00	$27,000
Traffic Signs	4	EA	$300.00	$1,200
Remove Traffic Signs	4	EA	$35.00	$140
Masonarry Unit Retaining Wall	800	SF	$24.00	$19,200
100 lbs of Calcium Chloride	100	BG	$40.00	$4,000
Hay Bales	200	EA	$8.00	$1,600
Silt Fence	1200	LF	$4.00	$4,800
Loam and Seed	7600	SY	$4.00	$30,400
Maintenance of Traffic	1	LS	$50,000.00	$50,000
Uniformed Police for Traffic Control	1	AL	$30,000.00	$30,000
Field Office	1	LS	$10,000.00	$10,000

NH Route 25:	$733,380
Fox Hollow Road:	$18,000
Total Construction:	$751,380
Engineering:	$160,000
Contingency (10%):	$91,000
Recommended Budget:	$1,002,380

Table 2.2
Preliminary Opinion of Probable Project Costs
45 MPH Design Speed: Widen and Overlay

DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	COST
Mobilization	1	LS	$27,000.00	$27,000
Clearing and Grubbing	1.6	AC	$5,000.00	$8,000
Utility Pole Relocation	7	EA	$2,500.00	$17,500
Large Tree Removal	6	EA	$800.00	$4,800
Exploratory Excavation	50	CY	$30.00	$1,500
Rock Excavation	50	CY	$200.00	$10,000
Excavation of Unsuitable Material	300	CY	$15.00	$4,500
Common Excavation	5700	CY	$10.00	$57,000
Embankment In-Place	470	CY	$4.00	$1,880
15" HDPE Drain Pipe	1400	LF	$35.00	$49,000
15" End Sections	3	EA	$140.00	$420
Catch Basin	7	EA	$2,500.00	$17,500
Sloped Granite Curb	1500	LF	$20.00	$30,000
Gravel	470	CY	$20.00	$9,400
Crushed Gravel	650	CY	$25.00	$16,250
Class C Stone	110	CY	$35.00	$3,850
HBP Temporary Pavement	300	TN	$80.00	$24,000
3" HBP Base Course	310	TN	$90.00	$27,900
2" HBP Binder Course	210	TN	$90.00	$18,900
1" HBP Wearing Course	420	TN	$90.00	$37,800
HBP Hand Method	80	TN	$140.00	$11,200
Reflective Paint Pavement Marking 4" Line	3000	LF	$0.20	$600
Reflective Paint Pavement Marking 12" Line	6000	LF	$0.25	$1,500
Remove Gaurdrail	900	LF	$2.50	$2,250
Gaurdrail	900	LF	$30.00	$27,000
Traffic Signs	4	EA	$300.00	$1,200
Remove Traffic Signs	4	EA	$35.00	$140
Masonarry Unit Retaining Wall	800	SF	$24.00	$19,200
100 lbs of Calcium Chloride	100	BG	$40.00	$4,000
Hay Bales	200	EA	$8.00	$1,600
Silt Fence	1200	LF	$4.00	$4,800
Loam and Seed	7600	SY	$4.00	$30,400
Maintenance of Traffic	1	LS	$50,000.00	$50,000
Uniformed Police for Traffic Control	1	AL	$30,000.00	$30,000
Field Office	1	LS	$10,000.00	$10,000

NH Route 25:	$561,090
Fox Hollow Road:	$18,000
Total Construction:	$579,090
Engineering:	$160,000
Contingency (10%):	$74,000
Recommended Budget:	$813,090

Table 2.3
Preliminary Opinion of Probable Project Costs
55 MPH Design Speed: Reclaim and Widen

DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	COST
Mobilization	1	LS	$46,000.00	$46,000
Clearing and Grubbing	1.8	AC	$5,000.00	$9,000
Utility Pole Relocation	7	EA	$2,500.00	$17,500
Large Tree Removal	6	EA	$800.00	$4,800
Exploratory Excavation	50	CY	$30.00	$1,500
Rock Excavation	50	CY	$200.00	$10,000
Excavation of Unsuitable Material	300	CY	$15.00	$4,500
Common Excavation	21700	CY	$10.00	$217,000
Embankment In-Place	540	CY	$4.00	$2,160
15" HDPE Drain Pipe	1700	LF	$35.00	$59,500
15" End Sections	3	EA	$140.00	$420
Catch Basin	7	EA	$2,500.00	$17,500
Sloped Granite Curb	1750	LF	$20.00	$35,000
Gravel	520	CY	$20.00	$10,400
Crushed Gravel	710	CY	$25.00	$17,750
Class C Stone	110	CY	$35.00	$3,850
Reclaimed Stabilized Base	5500	SY	$3.00	$16,500
Remove & Rehandle Reclaimed Stabilized Base	5500	SY	$4.00	$22,000
HBP Temporary Pavement	310	TN	$80.00	$24,800
3" HBP Base Course	1310	TN	$90.00	$117,900
2" HBP Binder Course	930	TN	$90.00	$83,700
1" HBP Wearing Course	470	TN	$90.00	$42,300
HBP Hand Method	80	TN	$140.00	$11,200
Reflective Paint Pavement Marking 4" Line	3500	LF	$0.20	$700
Reflective Paint Pavement Marking 12" Line	6500	LF	$0.25	$1,625
Remove Gaurdrail	900	LF	$2.50	$2,250
Gaurdrail	900	LF	$30.00	$27,000
Traffic Signs	4	EA	$300.00	$1,200
Remove Traffic Signs	4	EA	$35.00	$140
Masonarry Unit Retaining Wall	800	SF	$24.00	$19,200
100 lbs of Calcium Chloride	100	BG	$40.00	$4,000
Hay Bales	200	EA	$8.00	$1,600
Silt Fence	1200	LF	$4.00	$4,800
Loam and Seed	8800	SY	$4.00	$35,200
Maintenance of Traffic	1	LS	$50,000.00	$50,000
Uniformed Police for Traffic Control	1	AL	$30,000.00	$30,000
Field Office	1	LS	$10,000.00	$10,000

NH Route 25:	$962,995
Fox Hollow Road:	$18,000
Total Construction:	$980,995
Engineering:	$160,000
Contingency (10%):	$114,000
Recommended Budget:	$1,254,995

APPENDIX A

ROUTE 25/FOX HOLLOW ROAD TRAFFIC ANALYSIS

Laurie M. Rauseo, P.E., PTOE *Traffic Engineering • Transportation Planning*

152 Morrill Road
Canterbury, NH 03224

Phone: (603) 783-4802
Fax: (603) 783-4851

September 8, 2009

Mr. Raymond H. Korber, P.E.
KV Partners LLC
P.O. Box 7721
Gilford NH 03247

RE: Traffic Analysis
Route 25/Fox Hollow Road, Moultonborough

Dear Mr. Korber:

As per your request, I have conducted a traffic analysis of the intersection of Route 25/Fox Hollow Road in Moultonborough, New Hampshire.[1]

Background

The Route 25/Fox Hollow Road intersection was analyzed as part of the "NH Route 25 Corridor Study" prepared by Lakes Region Planning Commission in April 2008.[2] According to the study, "*The intent of the NH Route 25 Corridor Study is to assess the current conditions, identify potential safety improvements, assess potential future traffic demand based on development potential, and outline practical land use and access management strategies that can be implemented at the local level and in coordination with appropriate agencies*".

The Route 25/Fox Hollow Road intersection was identified as one of the "*leading safety concerns within the corridor study area*". Traffic counts were not conducted as part of the corridor study for this intersection. Accident data was collected and Fox Hollow Road was considered as part of a buildout analysis for the corridor. Based on the limited data available, the corridor study recommended short-term improvements such as "*modifying the drainage channel along the south side of NH Route 25 by adding a culvert under the Fox Hollow Road to raise and level the approach*" and installation of a "*crash avoidance system…in the absence of a road widening strategy*". Long term improvements recommended included a left turn lane if warrants are met. The purpose of my letter study is to provide the traffic data and analysis necessary to determine the appropriate improvements for the intersection.

Existing Conditions

Route 25 is a state maintained two lane roadway traversing the northern side of Lake Winnipesaukee between Route 3 in Meredith and Route 16 in Ossipee. Fox Hollow Road is a town-maintained road intersecting Route 25 approximately 1.25 miles east of the signalized intersection of Moultonborough Neck Road. Fox Hollow Road provides the sole access and egress for approximately 75 existing homes along Fox Hollow Road, Gilman Point Road, Acorn Lane, Moose Walk, and other roads. Most of the development in the neighborhood consists of single family

[1] This letter supersedes an August 17, 2009 draft version.
[2] NH Route 25 Corridor Study, Lakes Region Planning Commission with assistance provided by Fay, Spofford, and Thorndike, April 2008

homes located along the waterfront of Lake Winnipesaukee and Lee's Pond. Several larger, interior parcels are not developed at this time.

The intersection of Route 25/Fox Hollow Road is a "T"-intersection controlled by a STOP sign on Fox Hollow Road northbound. In the area of the intersection, the posted speed limit on Route 25 is 45 miles per hour. At the intersection, Route 25 is 26 feet wide both east and west of Fox Hollow Road with a soft shoulder on the north side and a gravel swale on the south side. Combination Curve/Intersection Ahead signs are located on both the eastbound and westbound approaches of Route 25 approximately 450-500 feet in advance of the intersection.

Fox Hollow Road intersects Route 25 just west of a horizontal curve and just east of the crest of a vertical curve. Fox Hollow Road is narrow, only 17-18 feet wide at a point just 30 feet south of the edge of the Route 25 traveled way. Route 25 is in a cut section and therefore, sloped embankments are close to both side of Route 25 at the intersection. Both sides of Fox Hollow Road are heavily wooded. These geometric conditions create the following safety concerns:

- Westbound Route 25 vehicles travel around the combination horizontal and vertical curves with limited sight distance of the intersection and any vehicle queued on Route 25 waiting to make a left turn into Fox Hollow Road;
- Eastbound Route 25 vehicles making a right turn into Fox Hollow Road must slow down considerably to navigate the narrow entrance to Fox Hollow Road, especially if another vehicle is waiting at the STOP sign on Fox Hollow Road;
- Eastbound Route 25 vehicles cannot safely maneuver around a right turn vehicle entering Fox Hollow Road due to the limited sight distance created by the combination horizontal and vertical curves; and,
- Left turn vehicles exiting Fox Hollow Road have limited sight distance to the east due to the alignment of Route 25 and the vehicle speeds.

Figure 1 - Route 25 looking east at Fox Hollow Road

Figure 2 - Fox Hollow Road with vehicle at STOP sign and vehicle turning right from Route 25

2009 Existing Traffic Volumes

Manual turning movement counts were conducted at Route 25/Fox Hollow Road on Tuesday, July 21, 2009 from 7:00-10:00 AM and 3:00-7:00 PM and on Saturday, July 18, 2009 from 10:00 AM-2:00 PM. On the weekday, peak traffic volumes occurred from 9:00-10:00 AM and from 3:15-4:15 PM. On Saturday, peak traffic volumes occurred from 11:00 AM – 12:00 PM. Traffic counts were conducted in July since the summer months are peak travel times for the Lakes Region and many homes in the Fox Hollow Road neighborhood are seasonal, waterfront homes. Peak hour volumes at the intersection are shown in Figure 3. Detailed traffic count data is included in the Appendix.

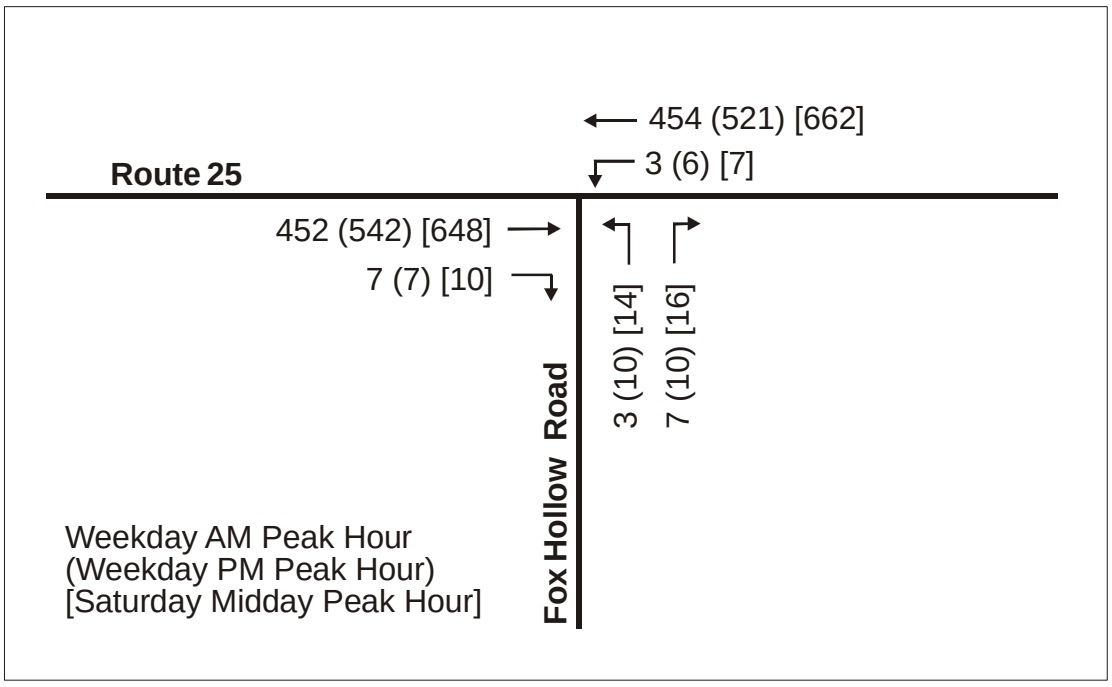


Figure 3 – 2009 Peak Hour Traffic Volumes

In addition to turning movement counts at the intersection, automatic traffic recorder counts were conducted on Route 25 east of Fox Hollow Road for 24 hours a day between Sunday, July 19, 2009 and Saturday, July 25, 2009. The average daily volume during that week was observed to be 13,700 vehicles per day. The highest volume occurred on Friday when 15,004 vehicles were recorded. Based on all the hours observed during that week, the highest hourly volume occurred on Saturday from 11:00 AM to 12:00 PM.

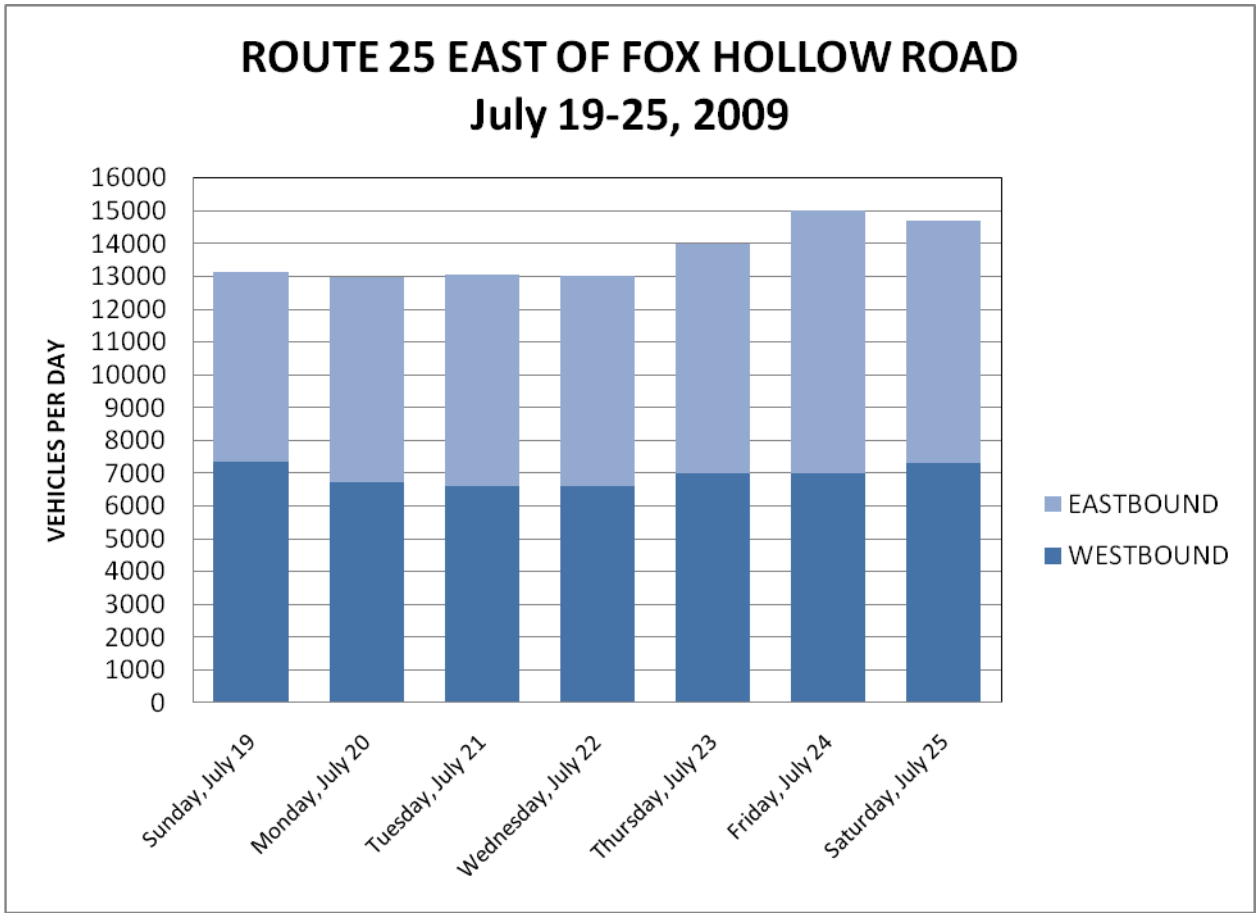


Figure 4 – 2009 Daily Volumes on Route 25

Vehicle Speeds

The automatic traffic recorders also collected vehicle speeds on Route 25 east of Fox Hollow Road. The speed studies show that median speeds (50th percentile) are approximately 5 miles per hour over the posted 45 mph speed limit. The 85th percentile speed was observed at 55 mph, 10 miles per hour over the posted speed limit. The majority of vehicles (68%) are traveling within a 45-55 mph pace.

TABLE 1 – ROUTE 25 EAST OF FOX HOLLOW ROAD - VEHICLE SPEEDS

	Westbound	Eastbound	Both Directions
50th Percentile Speed	51 mph	49 mph	50 mph
85th Percentile Speed	55 mph	54 mph	55 mph
Percent Vehicles > 45 mph	83%	75%	79%
Percent Vehicles > 50 mph	51%	39%	45%
Percent Vehicles > 55 mph	13%	8%	11%
Pace Speed 46-55mph, % of vehicles	69%	66%	68%

Accident History

Accident history for the Route 25/Fox Hollow Road intersection was received from the Moultonborough Police Department. Between 2000 and 2008, there were 13 reported motor vehicle accidents located at or near (within 300 feet of) the intersection. The accident summary is included in the Appendix. There were no significant trends identified however, the following was noted in the review of the data:

1. There were three accidents resulting in injuries out of 13 total.
2. Four accidents involved animals being struck along the road. Two other accidents were collisions with fixed objects.
3. Of the seven accidents involving collisions between two motor vehicles, one was classified as a "read end collision" and another was classified as a "right turn rear collision". No specific information is available on the other five motor vehicle collisions.
4. Of the 13 total accidents, five occurred during snowy conditions and one occurred during rainy conditions.
5. It is recognized that other accidents have occurred just beyond the influence area of the intersection, most notably a recent fatal accident related to the horizontal curve along Route 25 east of the intersection. (Information supplied by Moultonborough Chief of Police).

TABLE 2 – ROUTE 25/FOX HOLLOW ROAD ACCIDENT HISTORY (2000-2008)

YEAR OF ACCIDENT	2000-2002	2003-2005	2006-2008
Total Number of Accidents	**8**	**5**	**0**
Property Damage Only (Injury) [Fatality]	7 (1) [0]	3 (2) [1]	0 (0) [0]
Single Vehicle (2 or more vehicles involved)	4 (4)	1 (4)	0 (0)
Nature of Accident			
Motor Vehicle-Motor Vehicle	3	4	0
Hit Fixed Object (e.g. tree)	2	0	0
Animal	3	1	0

2029 Forecasted Traffic Volumes

This analysis considers traffic volumes under 2009 Existing Conditions and traffic volumes in the future analysis year of 2029. Discussions with the New Hampshire Department of Transportation, Bureau of Traffic, have determined that an appropriate background growth rate for Route 25 traffic is 1% per year. Therefore, to forecast Route 25 traffic passing Fox Hollow Road, a growth factor of 1.22 will be applied (1% per year, 20 years compounded).

For traffic entering and exiting Fox Hollow Road, the buildout analysis conducted by the Lakes Region Planning Commission for the Route 25 Corridor Study was reviewed. It was found that LRPC considered each parcel in the Fox Hollow Road neighborhood, determined the current land use and the potential number of single family house lots that could be created from any vacant parcels. Building constraints for each parcel were estimated and included conservation easements, slopes, soil types, setbacks to water bodies and wetlands. Based on the LRPC analysis, the neighborhood currently supports approximately 75 homes and could provide lots for an additional 115 homes. However, based on conversations with local realtors, the assessor's office and the planning department, some of the LRPC estimates may not be appropriate. For example, one of the larger vacant parcels was identified by the LRPC as being able to provide for 24 house lots from its 68 acres. That parcel was recently subdivided into five parcels. Based on this one example, the buildout analysis provided by LRPC could be too conservative. It is noted that the largest parcel in the neighborhood is 116 acres and is estimated

to have a potential buildout of 45 house lots. This one parcel represents nearly 40% of the total potential house lots estimated by LRPC for the area. The remaining vacant parcels have potential buildouts ranging from 1 to 14 lots.

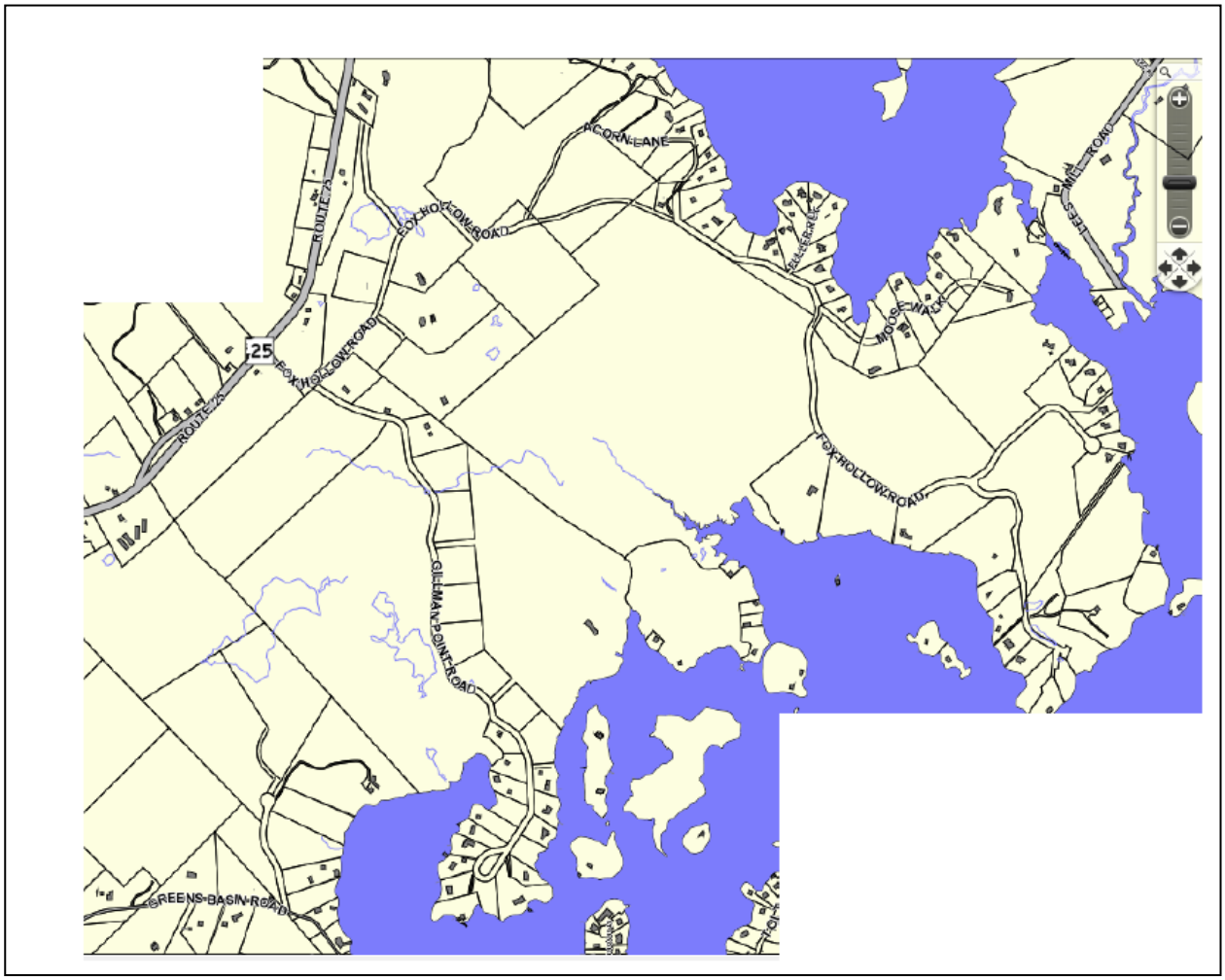


Figure 5 – Fox Hollow Road Area Parcel Map

For the purposes of this analysis, a buildout of 75 additional lots will be assumed to occur within the next 20 years, a doubling of the current number of houses in the area. This assumption may be conservative but is consistent with the population change in Moultonborough between 1980 and 2000, when the population doubled in 20 years. Traffic volumes entering and exiting Fox Hollow Road will be estimated to be twice the volumes in 2029 as compared with 2009. Figure 6 below provides the estimated 2029 turning movement volumes at Route 25/Fox Hollow Road.

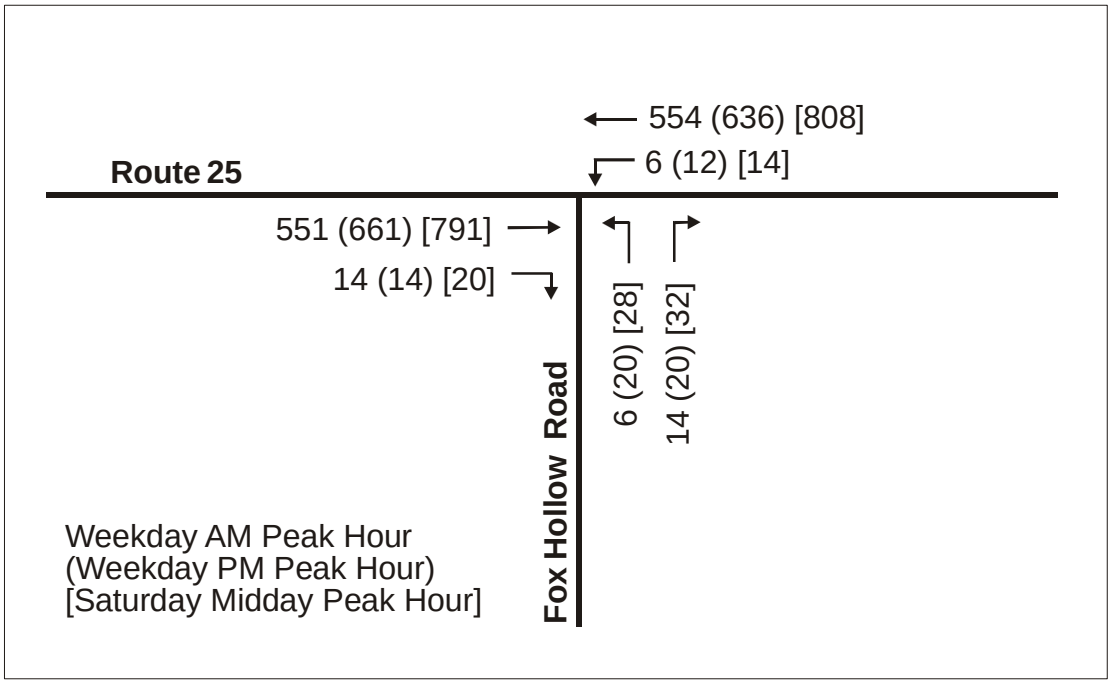


Figure 6 – 2029 Peak Hour Traffic Volumes

Sight Distance

As noted earlier, there is limited sight distance available at the intersection due to the horizontal and vertical curves along Route 25. One of the proposed improvements to the intersection, presented by others outside of this analysis, is to lower the profile of Route 25 at the intersection. The purpose of this section is to provide the design criteria when evaluating sight distance at the intersection. Sight distance is calculated for the design speed of the roadway. It is noted that the 85th percentile speed of vehicles on Route 25 at the intersection was observed to be 55 mph, 10 miles per hour over the posted speed limit.

Adequate *stopping sight distance* should be provided along the length of a roadway. According to A Policy on Geometric Design of Highways and Streets, a roadway with a 55 mph design speed needs to provide 495 feet of stopping sight distance.[3] In addition to providing adequate *stopping sight distance* along the major roadway, adequate *intersection sight distance* should be provided in both directions for vehicles entering and exiting an intersection. For vehicles exiting Fox Hollow Road, based on a design speed of 55 mph, 610 feet of *intersection sight distance* should be provided in both directions. For left turns from Route 25 westbound entering Fox Hollow Road, 445 feet needs to be provided. If the proper *stopping sight distance* is provided along Route 25 (495 feet), then adequate *intersection sight distance* for left turns from Route 25 will be available.

Auxiliary Turn Lane Analysis – Left Turns

There are no separate turning lanes currently provided on the major road, Route 25, at Fox Hollow Road. A Policy on Geometric Design of Highways and Streets provides guidelines for the consideration of left turn lanes on two-lane highways.[4] The guidelines include consideration of the

[3] A Policy on Geometric Design of Highways and Streets, Fourth Edition, American Association of State Highway and Transportation Officials, 2001, Exhibit 3-1
[4] ibid, Exhibit 9-75

roadway travel speed, percentage of left turns in the advancing volume, total advancing volume and opposing traffic volume. A left turn lane creates an additional lane exclusively for left turning traffic such that the through vehicles would not have to shift to pass a stopped left turning vehicle. If a left turn lane is not warranted, a "bypass shoulder" can be considered. The bypass shoulder provides for a 10-12' shoulder to allow through vehicles to pass a stopped vehicle waiting to turn left.

The AASHTO guidelines were used to develop an interactive spreadsheet found in NCHRP Report 457, Engineering Study Guide for Evaluating Intersection Improvements.[5] The interactive spreadsheet allows for interpolation of the AASHTO guidelines where necessary. For example, the AASHTO guidelines refer to vehicle speeds of 50 mph and 60 mph but at this intersection, the 85th percentile speeds are 55 mph. For each of the critical peak hours during the weekday and Saturday, and considering 2009 versus 2029 traffic volumes, a left turn warrant analysis was conducted utilizing the interactive spreadsheet found in NCHRP 457. The results are included in the Appendix and summarized in Table 3 below.

TABLE 3 - LEFT TURN LANE WARRANTS – ROUTE 25 WESTBOUND AT FOX HOLLOW ROAD

CRITERIA	WEEKDAY PM PEAK HOUR		SATURDAY MIDDAY PEAK HOUR	
	2009	2029	2009	2029
Advancing Volume (WB)	527	648	669	822
Opposing Volume (EB)	549	675	658	811
Left Turn Volume (WB)	6	12	7	14
Left Turn % of Advancing	1.1%	1.9%	1.1%	1.7%
Left Turn Warrant Met?	No	Yes	Yes	Yes

As noted in Table 3, left turn lane warrants were met, using the interactive spreadsheet, considering the Saturday midday peak hour volume in 2009 (but not the weekday PM peak hour) and considering both critical peak hours in 2029. However, it should be noted that the left turn volumes are very low, less than 10 vehicles in the peak hour in 2009 and less than 15 vehicles in the peak hour in 2029. In all peak hours, left turn volumes contribute less than 2% of the advancing volumes on Route 25 westbound. The AASHTO guidelines and many references for left turn lane warrants include charts or graphs for cases of left turns at 5%, 10%, 20% or 30% of advancing volumes. Therefore, for this particular case, the interactive spreadsheets found in NCHRP 457 are important since they interpret the underlying equations to account for low percentages of left turns.

Auxiliary Turn Lane Analysis – Right Turns

Guidelines for adding right turn lanes on two-lane highways are found in NHCRP Report 279, Intersection Channelization Design Guide.[6] These guidelines consider the total peak hour approach volume, vehicle speeds, and right turn volumes. They are presented in a chart noting the volumes at which a right turn taper is suggested and a full width right turn lane is suggested. According to this resource, the minimum number of right turns on the major road which would warrant a taper or turn lane is 20 right turns in the peak hour.

Right turn lane warrants are also found in NCHRP Report 457, Engineering Study Guide for

[5] NCHRP Report 457, Engineering Study Guide for Evaluating Intersection Improvements, Transportation Research Board, 2001
[6] Intersection Channelization Design Guide, NCHRP Report 279, Transportation Research Board, 1985, Figure 4-23

Evaluating Intersection Improvements.[7] The minimum volume to trigger the warrant is approximately 10 right turns using this resource. An interactive spreadsheet is also available for this analysis, and the results are included in the Appendix. As shown in Table 4, based on a review of two different right turn lane warrants, the right turn volumes on Route 25 eastbound at Fox Hollow Road warrant consideration of a right turn lane or right turn taper under 2029 peak hour conditions.

TABLE 4 – RIGHT TURN LANE WARRANTS – ROUTE 25 EASTBOUND AT FOX HOLLOW ROAD

CRITERIA	WEEKDAY PM PEAK HOUR		SATURDAY MIDDAY PEAK HOUR	
	2009	2029	2009	2029
Advancing Volume (EB)	549	675	658	811
Right Turn Volume (EB)	7	14	10	20
Right Turn Warrant Met? – NCHRP 279	No	No	No	Taper
Right Turn Warrant Met? – NCHRP 457	No	Right Turn Bay	No	Right Turn Bay

Traffic Signal Warrant Analysis

Traffic control signals should not be installed unless warranted as per the Manual on Uniform Traffic Control Devices.[8] The eight warrants in the MUTCD consider several factors such as traffic volumes, vehicle speeds, pedestrian volumes, school crossings, and crash experience. The intersection of Route 25/Fox Hollow Road was reviewed for traffic signal warrants. A summary of the analysis is provided in Table 5. Complete descriptions of each signal warrant is found in the MUTCD. As shown in Table 5, the intersection of Route 25/Fox Hollow Road does not meet any of the MUTCD traffic signal warrant criteria.

TABLE 5 - TRAFFIC SIGNAL WARRANT ANALYSIS

ROUTE 25/FOX HOLLOW ROAD		
MUTCD SIGNAL WARRANT	**ANALYSIS**	**WARRANT MET?**
1 - Eight-Hour Vehicular Volume	based on traffic counts conducted – criteria reflects higher speeds on Route 25 and single lane approaches, volumes are too low on Fox Hollow Road	NO
2 - Four-Hour Vehicular Volume	similar to Warrant 1	NO
3 - Peak Hour	similar to Warrant 1	NO
4 - Pedestrian Volume	pedestrian volumes are very low in the study area	NO
5 - School Crossing	no school crossing at the intersection	NO
6 - Coordinated Signal System	no other nearby signals	NO
7 - Crash Experience	criteria is "…five or more reported crashes, of types susceptible to correction by a traffic control signal, have occurred within a 12-month period…" Crash data does not support this warrant	NO
8 - Roadway Network	peak hour volume is greater than 1000 vehicles entering, however, intersection is not junction of two major routes	NO

Capacity Analysis – Methodology

Capacity analysis is performed to determine how the Route 25/Fox Hollow Road intersection

[7] NCHRP Report 457, Engineering Study Guide for Evaluating Intersection Improvements, Transportation Research Board, 2001
[8] Manual on Uniform Traffic Control Devices, United States Department of Transportation, Federal Highway Administration, 2003

is operating. The methods of the Highway Capacity Manual[9] were used to analyze study area intersections. The Highway Capacity Manual uses Level of Service (LOS) to describe the operation of both unsignalized and signalized intersections.

The methodology for signalized intersection analysis includes consideration of traffic conditions, intersection geometry, and signal operation. The methodology for unsignalized intersections (two-way stop-controlled and all-way stop-controlled) is based on the number and size of gaps in the major street traffic that allow a vehicle to pass through or enter the major street. The number and size of gaps is influenced by the traffic volumes on all legs of the intersection and the priority of the movement under consideration, i.e. left turns from the major street would have right of way priority over left turns on the minor street.

The level of service is based on average control delay per vehicle and ranges from LOS A (very good operation) to LOS F (unacceptable, oversaturated conditions) as shown in Table 6 below. Control delay includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay.[10]

TABLE 6 - LEVEL OF SERVICE CRITERIA FOR INTERSECTIONS

LEVEL OF SERVICE	CONTROL DELAY PER VEHICLE (seconds)	
	SIGNALIZED	UNSIGNALIZED
LOS A	≤10	≤10
LOS B	>10 and ≤20	>10 and ≤15
LOS C	>20 and ≤35	>15 and ≤25
LOS D	>35 and ≤55	>25 and ≤35
LOS E	>55 and ≤80	>35 and ≤50
LOS F	>80	>50

Capacity Analysis - Results

As shown in Table 7, left turns from Route 25 westbound operate at LOS A in all peak hours. Left and right turns from Fox Hollow Road operate at LOS C in the critical peak hours in 2009. In 2029, the projected level of service for these movements is LOS D in the weekday PM peak hour and LOS E in the Saturday midday peak hour. These results show that the intersection is operating with mid-range delays. Since the estimated delays are not excessive, separate turn lanes are not required on Fox Hollow Road to shorten delays. Detailed capacity analysis results are provided in the Appendix.

TABLE 7 – CAPACITY ANALYSIS – ROUTE 25/FOX HOLLOW ROAD – EXISTING GEOMETRY

INTERSECTION MOVEMENT	Level Of Service (Average Control Delay – Seconds Per Vehicle)			
	WEEKDAY PM PEAK HOUR		SATURDAY MIDDAY PEAK HOUR	
	2009	2029	2009	2029
Route 25 WB Left Turn	LOS A (9)	LOS A (9)	LOS A (9)	LOS A (10-)
Fox Hollow Road Left/Right Turn	LOS C (18)	LOS D (27)	LOS C (22)	LOS E (41)

As discussed earlier, a westbound left turn lane is warranted on Route 25. An eastbound right turn lane is marginally warranted and it is recommended that a right turn taper on Route 25 be

[9] Highway Capacity Manual, HCM 2000, Transportation Research Board, 2000
[10] ibid, page 16-1

provided. The analysis shown in Table 7 does not consider these proposed improvements. Therefore, additional capacity analysis was conducted considering a westbound left turn lane on Route 25. As shown in Table 8, the capacity analysis results are the same with the proposed left turn lane added to Route 25. This is due to the very low left turn volumes using the lane. Detailed capacity analysis results are provided in the Appendix.

TABLE 8 – CAPACITY ANALYSIS – ROUTE 25/FOX HOLLOW ROAD – PROPOSED GEOMETRY

INTERSECTION MOVEMENT	Level Of Service (Average Control Delay – Seconds Per Vehicle)			
	WEEKDAY PM PEAK HOUR		SATURDAY MIDDAY PEAK HOUR	
	2009	2029	2009	2029
Route 25 WB Left Turn	n/a	LOS A (9)	n/a	LOS A (10-)
Fox Hollow Road Left/Right Turn	n/a	LOS D (27)	n/a	LOS E (41)

Recommendations

The purpose of this report was to present the results of field visits, traffic counts, vehicle speed studies, accident history research, auxiliary turn lane warrant analysis, traffic signal warrant analysis and capacity analysis for the intersection of Route 25/Fox Hollow Road in Moultonborough, New Hampshire. Based on the data and analysis contained herein, I have the following recommendations for your consideration:

Recommendation #1:

A left turn lane should be constructed on Route 25 westbound at Fox Hollow Road.

- Heavy through traffic volumes on Route 25 combined with high vehicle speeds create a low threshold for meeting the left turn lane warrants. Despite relatively low left turn volumes from Route 25 into Fox Hollow Road, left turn lane warrants were met considering 2009 and 2029 peak hour volumes.
- Turning volumes at Fox Hollow Road were based on one day of counts during a typical weekday and Saturday in the summer. Left turn lane warrants were met based on these typical conditions. Since left turn volumes may be higher on Friday evenings and holiday weekends, provision of a left turn lane would accommodate peak conditions as well.
- A left turn lane will move left turning vehicles from the westbound lane, reducing delays for through vehicles and reducing the potential for rear end collisions.
- Limited sight distance around the horizontal curve on Route 25 is a contributing safety factor when considering the need for a left turn lane.
- If a left turn lane cannot be provided due to physical, environmental or fiscal constraints, a bypass shoulder should be constructed, at a minimum.

Recommendation #2:

A right turn taper should be constructed on Route 25 eastbound at Fox Hollow Road.

- As mentioned above for the left turns, heavy through traffic volumes on Route 25 combined with high vehicle speeds create a low threshold for meeting the right turn lane warrants. A right turn taper was found to be warranted based on the right turn volume.
- A right turn taper will move right turning vehicles from the eastbound lane more quickly, resulting in less delays to through vehicles and reducing the potential for rear end collisions.

Recommendation #3:

The width of Fox Hollow Road near Route 25 should be increased to at least 24 feet wide.

- Provision of adequate turning radii and an adequate width on Fox Hollow Road will allow vehicles to enter and exit from Route 25 more safely. The difference in speed between through vehicles and turning vehicles is a safety issue.

Recommendation #4:

Adequate stopping sight distance and intersection sight distance based on the observed 85th percentile speeds along Route 25 should be provided if possible.

- The posted speed limit is 45 miles per hour, however, road design is typically based on the 85th percentile speed. Provision of sight distance requirements at the 85th percentile speed (observed at 55 mph) should improve safety at the intersection.

I trust this information has been helpful. Please call me if you have any questions.

Sincerely,

Laurie M. Rauseo

Laurie M. Rauseo, P.E., PTOE

APPENDIX B

NH ROUTE 25 CORRIDOR STUDY

Additionally, the field review found several signs indicating school buses stop along the corridor, but the actual school bus turnouts are not clearly indicated. Well-marked school bus bays should be considered along the corridor in coordination with affected local school district needs. Along with pedestrian walking route enhancements, such bus bays may be eligible for funding under the Federal Highway Administration (FHWA) Safe Routes to School program. In village areas, school bus bays could also be used to provide public transportation stops during the peak summer season, thereby having year-round use. A typical school bus bay would be approximately 50 feet long and 12 feet wide with 25-foot-long transition lengths.

Corridor View Looking East

Fox Hollow Road at NH Route 25

Located on a segment of NH Route 25 that has a speed limit of 45 miles per hour, the Fox Hollow Road intersects NH Route 25 in a 'T' intersection. Traffic counts were unavailable for the intersection. East of the intersection, a hillcrest impairs visibility of the intersection. NH Route 25 has a drainage channel dip between the NH Route 25 roadway surface and Fox Hollow Road. The evidence of scraping along the front of the road indicates many vehicles have bottomed out making left or right turns from NH Route 25 into or out of Fox Hollow Road (see Illustration 4.1).

Recommendations include modifying the drainage channel along the south side of NH Route 25 by adding a culvert under the Fox Hollow Road to raise and level the approach. This will ease turning movements into and out of Fox Hollow Road, thereby reducing the potential for rear end collisions. A crash avoidance system (see Appendix E) could be considered in the absence of a road widening strategy. As Illustration 4.2 shows, if left turn lane warrants are met, a westbound left turn or bypass lane should also be considered for installation. An overhead sign indicating the street name should also

be considered under a NH DOT test. Refer to Appendix E for an illustration of overhead signs allowed under current Manual on Uniform Traffic Control Devices (MUTCD). This technique might also be considered at other 'T' intersections along NH Route 25, particularly as a measure prior to the installation of a left turn lane, which involves costly widening, drainage modifications, taking of green space, vertical hill removal, and possible construction of walls.

Illustration 4.1: Preliminary Short-Term Improvement Strategy at NH Route 25/Fox Hollow Road

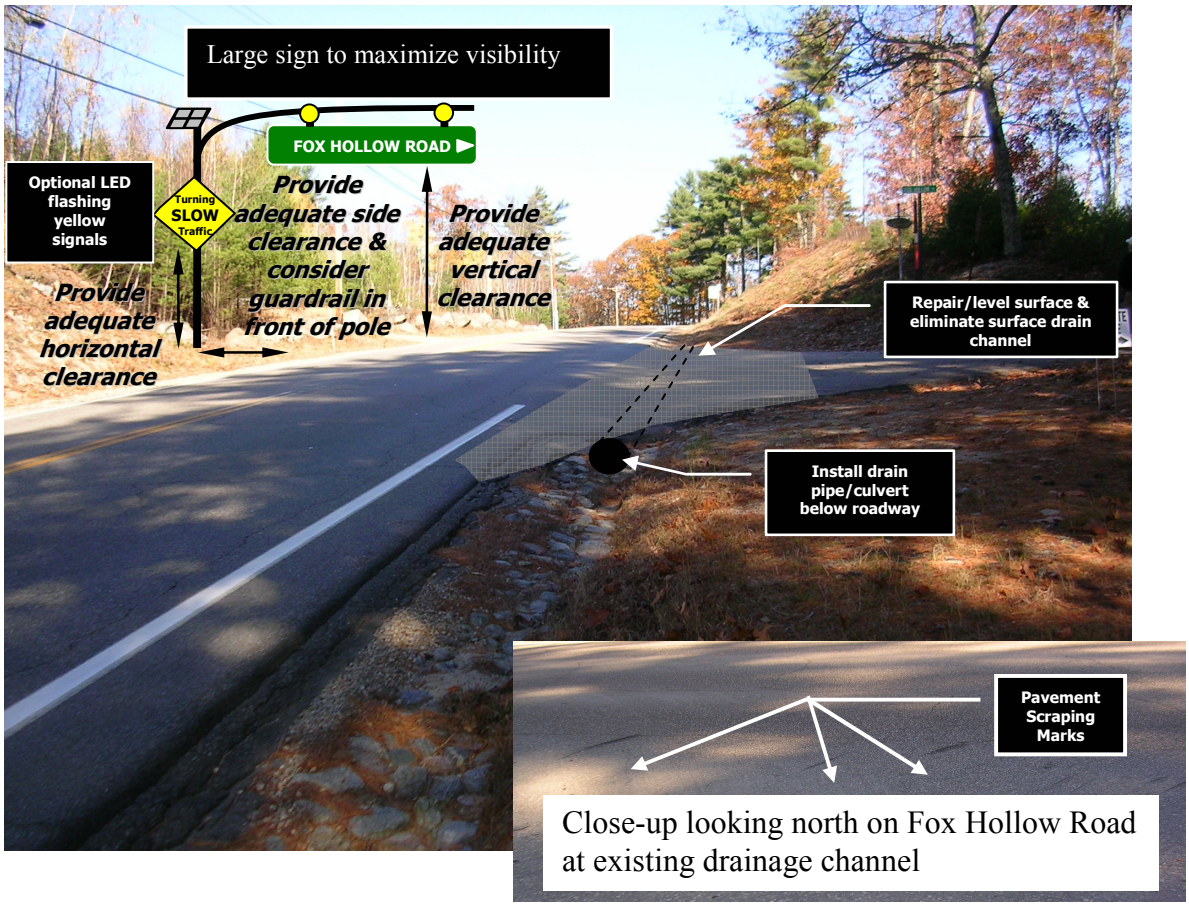
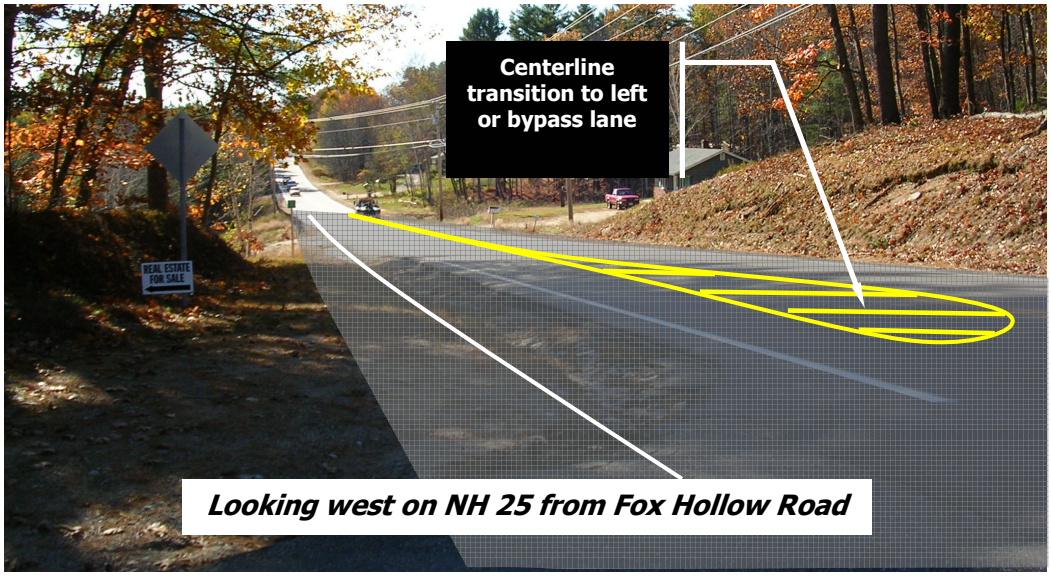


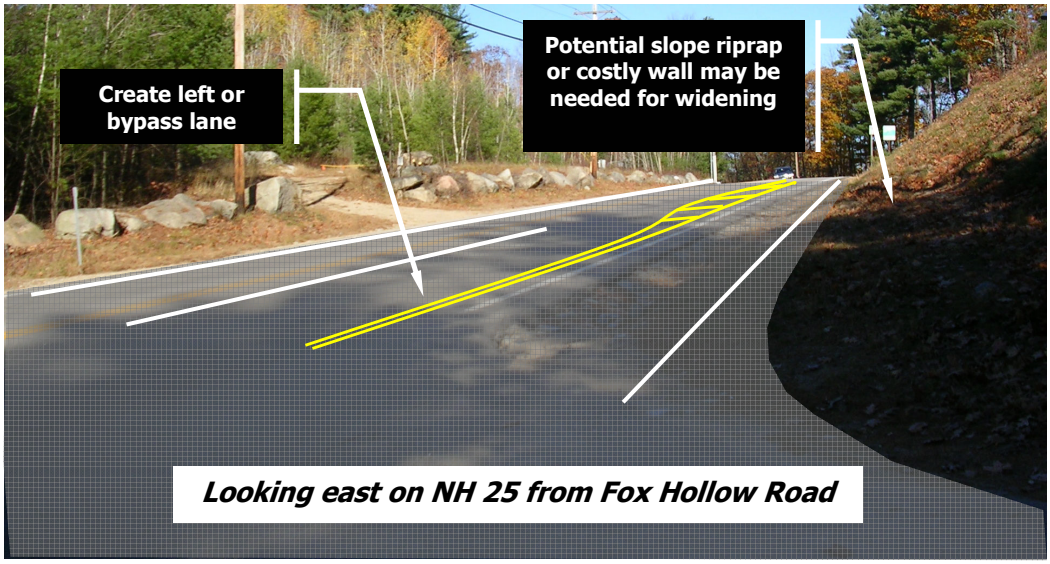
Illustration Notes:

- Advance warning signs needed in both directions – possible crash avoidance system (Illustrated in Appendix E).
- Design overhead or highly-visible street name signs in accordance with MUTCD and NH DOT requirements.
- Same signs must be visible in both directions.
- If used, place overhead street sign at the centerline of Fox Hollow Road.
- Optional alternating LED flashing signals (on pole or overhead), possibly solar powered.

Based on observations, an ideal long-term solution for the Fox Hollow Road intersection with NH Route 25 would also include the creation of a westbound bypass lane (requires less right-of-way) or, if warrants are met, the creation of an exclusive westbound left turn lane into Fox Hollow Road. As seen belowin Illustration 4.2, widening NH Route 25 is problematic in that it might involve the construction of a wall or rip-rap slope on the south side of the highway to create a 10--12 foot wide left turn or bypass lane. Refer to Appendix F for sketches of existing conditions, proposed improvement strategies, and cost estimates for safety improvements.

Illustration 4.2: Preliminary Long-Term Improvement Strategy at NH Route 25/Fox Hollow Road





APPENDIX F: Fox Hollow Road – Safety Improvements Cost Estimate

Fox Hollow Road - Estimate of Quantities

Item No.	Description	Unit	Estimated Total	Unit Price	Total
	PAVEMENT				
203.3	UNCLASSIFIED EXCAVATION - 30"	CY	750	$10.00	$7,500.00
304.1	SAND (F) - 8"	CY	200	$22.00	$4,400.00
304.2	GRAVEL (F) - 8"	CY	200	$23.00	$4,600.00
304.3	CRUSHED GRAVEL (F) - 8"	CY	200	$26.00	$5,200.00
403.11	HOT BITUMINOUS PAVEMENT, MACHINE METHOD	TON	300	$60.00	$18,000.00
628.2	SAWCUT	LF	1100	$2.00	$2,200.00
632.0104	RETROREFLECTIVE PAINT PAVE. MARKING, 4" LINE	LF	2800	$0.50	$1,400.00
632.02	RETROREFLECTIVE PAINT PAVEMENT MARKING, SYMBOL OR	SF	60	$1.35	$81.00
	MISC.				
	OVERHEAD SIGN WITH POST	EA	1	$50,000.00	$50,000.00
670.	ADVANCED WARNING SIGN	EA	2	$2,000.00	$4,000.00
	EARTH WORK				
203.1	COMMON EXCAVATION	CY	1400	$5.00	$7,000.00
	RETAINING WALL				
670.	PRECAST CONCRETE SEGMENTAL RETAINING WALL	SF	2500	$30.00	$75,000.00
	DRAINAGE				
	HEADWALLS	EA	2	$3,000.00	$6,000.00
585.3	STONE FILL, CLASS C	CY	130	$47.00	$6,092.59
593.411	GEOTEXTILE: PERM. EROSION CONTR. CLASS 1, NONWOVEN	SY	350	$3.00	$1,050.00
603.00212	12" R.C. PIPE, 2000D	LF	25	$40.00	$1,000.00
	GUARD RAIL				
606.140	BEAM GUARDRAIL (STANDARD SECTION- WOOD POSTS)	LF	300	$20.00	$6,000.00

Fox Hollow Road - Estimate of Quantities

Item No.	Description	Unit	Estimated Total	Unit Price	Total
606.147	BEAM GUARDRAIL (TERMINAL UNIT TYPE G-2)	U	2	$550.00	$1,100.00
	SubTotal				$200,623.59
	OTHER:				
	MOBILIZATION (10%)				$20,062.36
	EROSION CONTROL (5%)				$10,031.18
	TRAFFIC CONTROL (5%)				$10,031.18
	CONTINGENCIES (30%)				$60,187.08
	SubTotal				$100,311.80
	TOTAL				$300,935.39
	TOTAL ESTIMATE			SAY	$300,000.00

Notes:
1. This estimate is based on a Concept Plan which shows only approximate existing conditions that are not from instrument field survey. Proposed conditions are based on limited engineering and are conceptual in nature. The Concept Plan is not for construction; it was prepared for conveying feasible improvement options in a general way. The total estimate is therefore approximate and suitable only for general planning purposes. The quantities and corresponding costs could vary significantly upon completion of a field survey base plan and preliminary designs.

2. The Fox Hollow Road estimate provided above generally includes the approximate cost for pavement widening, markings and overhead / advanced warning signage. The amount of pavement widening as well as the length/height of retaining wall required to implement this concept has been approximated. This is based on minimal technical information and is therefore subject to significant change during design. A potential cost savings could be realized through slope work in lieu of retaining walls provided that potential slope stabilization, rock excavation and Right of Way issues are not substantial (can not be determined at this time). Unit prices are based on FY 2007 weighted average bid prices published by NHDOT. Additional items such as mobilization, erosion control, and traffic control are approximated through typical %.

3. The price for advanced warning signage indicated above assumes standard NHDOT signs. The cost for vehicle-actuated advanced warning system has not been included. The cost to install such a system would be on the order of an additional $50,000.

APPENDIX C

FOX HOLLOW ROAD INTERSECTION ENGINEERING STUDY

THE Louis Berger Group, INC.
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Tel 603 644 5200 Fax 603 644 5220 www.louisberger.com

January 4, 2008

Mr. Natt King, Planning Board Chairman
Town of Moultonborough
PO Box 139, 6 Holland Street
Moultonborough, NH 03254

RE: Fox Hollow Intersection
Engineering Study

Dear Mr. King:

Please find enclosed eight copies of our Engineering Study for this intersection. The Louis Berger Group identified and studied several alternatives to address safety concerns at this intersection. Based on discussions and direction by the Board, we have proceeded with conceptual design and cost estimates for the two preferred alternatives.

One of these alternatives involves reconstructing approximately 900 feet of NH Route 25 to improve the Intersection Sight Distance for vehicles exiting from the Fox Hollow Road onto Route 25. The estimated total project cost (excluding right of way) for this improvement is $320,000.

The other alternative involves the construction of a new Fox Hollow Connector Road to provide a new intersection with Route 25 approximately 2000 feet to the east of the existing intersection. The alignment of the new connector would follow generally along an existing private easement. The estimated total project cost (excluding right of way) of this improvement is $200,000. The section of Fox Hollow Road from the Connector back to Gilman Point Road should be improved to handle the increased traffic. This would add another $120,000 to the estimated total project cost (excluding right of way).

Please contact me if you have any questions or need additional information. I am available to discuss this report at the convenience of the Board.

Very truly yours,
THE **Louis Berger Group,** INC.

Anthony M. Puntin, PE
Director, Civil Engineering

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INTRODUCTION AND BACKGROUND

The Town of Moultonborough (Town) has retained The Louis Berger Group Inc. (Berger) to provide an engineering analysis and construction cost estimates for various alternatives for the improvements to the Fox Hollow Road and Route 25 Intersection. Fox Hollow Road intersects with NH Route 25 on the south side of Route 25 and provides the only means of access for approximately 60 residences on Fox Hollow Road and Gilman Point Road. In addition to the existing residences, the area served by Fox Hollow Road has the potential for further development, which could increase the difficulties currently experienced at this intersection.

The main concern with the current intersection relates to limited sight distance along Route 25. The Fox Hollow Road intersection is located approximately 300' west of the crest of a vertical curve on Route 25 (refer to Figure 1). The existing posted speed on Route 25 at this location is 45 miles per hour, and the vertical profile does not provide a safe intersection sight distance in the easterly direction. Vehicles exiting Fox Hollow Road in a westbound direction have limited sight distance to their right (i.e. looking east) and do not have adequate time to determine if they can safely enter onto Route 25. In addition, vehicles headed westbound on Route 25 have limited sight distance over the roadway crest. Vehicles queued for a left turn onto Fox Hollow Road are "hidden" over the crest for westbound traffic on Route 25. As volumes increase on both Route 25 and on Fox Hollow Road, these deficiencies will result in higher safety concerns.

The study was initiated by the submission to the Planning Board of a proposed 5-lot subdivision on Gilman Point Road. This roadway directly connects to and can only be accessed via Fox Hollow Road. Therefore any additional traffic generated by the new homes would increase the safety concerns at the intersection of Fox Hollow Road at Route 25.

A meeting was held at the Moultonborough Town Hall on Tuesday September 11, 2007 to review the project status, discuss the history of improvements considered for the intersection, and to develop an understanding of the engineering services requested by the Town. The proposed development has led to the re-immergence of discussions relative to the safety of the intersection of Fox Hollow and Route 25. In the late 1980's, design plans for proposed improvements at this intersection were developed but never implemented. Additionally, very conceptual sketches were generated to relocate the intersection further to the east.

SCOPE OF SERVICES

Based on discussions with the Planning Board, Berger developed a Scope of Services to study this intersection. The Scope of Services is provided below:

Task 1 – Data Collection/Base Plan Development
A thorough review of all pertinent plans and records for the Fox Hollow area will be conducted. Particular attention will be paid to any traffic data available. The Lakes Region Planning Commission (LRPC) and NHDOT will be contacted relative to available traffic data. The existing town mapping (AutoCAD file with property lines) will be used as a base plan for the Alternatives Investigation. Site visits will be conducted to evaluate the existing conditions and to observe the traffic operations at the intersection. Features noted during the site visit will be incorporated into the base plan.

Task 2 – Alternatives Investigation
As described above, several alternatives for the reconfiguration or reconstruction of this intersection have been discussed for several years. For this phase, Berger will provide planning level designs for approximately 3 alternatives. These designs could include sight distance improvements, the addition of turning or bypass lanes, and the relocation of the intersection. Based upon traffic volumes and crash data obtained from the Town, a warrant analysis will be conducted to determine the need for tuning lanes. If current traffic data on turning movements at the intersection are not available, the estimated volumes will be determined by the utilizing the number of residences.

An evaluation of the design alternatives will be conducted relative to several factors including, but not limited to, impacts to resources (wetlands), improved safety, community support, and cost. The alternatives study results will be presented to the public at a regularly scheduled Planning Board Meeting. This will allow the Board to gauge community support for the alternatives.

Task 3 – Conceptual Design
After review of the alternatives and in consultation with Board, a preferred alternative for the intersection improvements will be developed. Ground survey for the proposed improvements will be obtained. This will allow for a more accurate accounting of the impacts. The preferred design will be refined based upon the new topographical information obtained. Conceptual design plans (including plan, profile, and cross sections) will be prepared and submitted to the Town. The completion of survey in this phase will also allow for the development of the final design and construction documents for the intersection reconstruction.

During November and December of 2007, several site visits were conducted to review the project area. Observations were made as to the intersection operation and deficiencies. Meeting and discussions were also conducted with personnel from the Town, the Lake Region Planning Commission, and the New Hampshire Department of Transportation (NHDOT). Existing traffic data and design plans (c. 1940) for the construction of Route 25 were also reviewed.

DATA COLLECTION

As noted, this intersection has been the subject of discussions, studies, and proposals over a number of years. The following documents were reviewed to provide a background understanding of the issues and the previous proposed actions:

- Plans for the reconstruction of NH Rote 25, dated 1939 were obtained from the NHDOT
- Plans for proposed Fox Hollow Road Improvements, prepared by Rist-Frost Associates in February 1989, which provided for the construction of a west-bound by-pass lane on Route 25 to allow through vehicles room to travel beside vehicles waiting for gaps in the traffic flow
- Memorandum by Stephen G. Pernaw dated August 14, 2007 regarding Crash Data Research at this intersection
- Individual Location Audit Summary: Fox Hollow Rd &Rte 25 dated August 29, 2007 by

The T2 Center at UNH

- Letter Report by L.C. Engineering dated September 25, 2007 regarding the sight distance at this intersection
- Letter Report by L.C. Engineering dated October 22, 2007 regarding the potential construction of a new road from Fox Hollow Road to Route 25, intersecting with Route 25 near the NHDOT maintenance facility.
- Letter dated October 26, 2007 from Keld Agnar, containing historical correspondence relative to this intersection
- Traffic volume data was obtained from the NHDOT files which showed an Average Daily Traffic (ADT) volume of approximately 11,000 vehicles per day on Route 25. In addition, turning movement counts have been conducted at several near-by intersections by the Lakes Region Planning Commission as part of the current Route 25 Corridor Study. Although volumes were not taken at Fox Hollow Road, this intersection is one of the intersections that will be studied as part of this report.

ALTERNATIVES

One of the key elements of the Study was the development and review of various design alternatives for intersection improvements. Based on our review of the previous studies and our own inspections, a comprehensive list of potential alternatives to improve this intersection was prepared for discussion. These alternatives were presented to the Planning Board on November 28, 2007. A copy of the meeting minutes is included at the end of this document. The positive and negative aspects of the alternatives were also reviewed with the Board at that time. Since Route 25 is controlled by the NHDOT, coordination with this agency was included in the alternatives analysis. A site meeting was arranged with representatives of the NHDOT District 3 office and several members of the Planning Board on December 5, 2007. The alternatives presented to the Board and to NHDOT for consideration were as follows:

1. Install intersection warning signs
    a. Lowest Cost
    b. Not very effective

2. Lower posted speed limit
    a. Requires engineering study to justify
    b. Accident record does not appear to warrant
    c. May not be approved by NHDOT

3. Install flashing overhead beacon
    a. Requires engineering study to justify
    b. Accident record does not appear to warrant
    c. Maintenance/operation costs
    d. May not be approved by NHDOT

4. Improve sight distance to the east by re-grading the embankment on the southeast corner
    a. Would require easement/taking from property owner
    b. Would allow vehicles on Fox Hollow Road to stop further back, but would not increase sight distance of vehicles on Route 25

5. Construct westbound by-pass shoulder
    a. Would allow through vehicles to by-pass left turn vehicles
    b. Would probably decrease rear-end crashes
    c. May increase other types of crashes
    d. Could tend to increase speeds
    e. Could make it more difficult to exit out of Fox Hollow Road
    f. Widening could require land takings or easements

6. Construct left turn lane for westbound vehicles
    a. Similar to Option 5, but safer
    b. Traffic volumes do not appear to warrant

7. Improve sight distance by reconstructing and re-grading Route 25
    a. Expensive
    b. Would require land takings and/or easements
    c. Difficult control of traffic during construction

8. Relocate intersection to the west
    a. Would require land taking
    b. Would improve sight distance

9. Relocate intersection to the east
    a. Would require land taking
    b. Would improve sight distance

10. Construct new alternative roadway to intersect with Route 25 near the NHDOT maintenance facility
    a. Most expensive alternative
    b. Would require land takings
    c. Would probably have wetland impacts
    d. Would increase traffic volume on the westerly portion of Fox Hollow Road which would require improvements

A good deal of discussion at the meetings focused on the potential for improved safety for each alternative. While Alternatives 5 and 6 have been discussed many years, it was felt that they would not address the site distance concerns at the intersection. Additionally, there was a good deal of discussion as to the purpose of the Study and how it relates to the proposed 5-lot subdivision. The Board expressed that it is their intention to use the estimated construction cost to assess a fee to the developer based on a percentage of the cost of the preferred alternative.

PREFERRED ALTERNATIVES

The Board, upon review and discussion of the Alternatives, instructed Berger to provide a more detailed evaluation of Alternatives 7 and 10 and prepare construction cost estimates for these alternatives. Figure 2 provides a plan indicating the location and limits of the proposed work. Plans of the Route 25 reconstruction were obtained from the NHDOT and provided the base

information for Alternative 7. Limited field survey was conducted along the easement from Fox Hollow Road to Route 25 and along the existing section of Fox Hollow Road from Gilman Point Road to the easement. A more detailed description of these alternatives and the findings is as follows:

Alternative 7 – Reconstruct Route 25

The main concern expressed by the Board was the need to address the sight distance concerns along Route 25. Utilizing the original design plans for Route 25, an alternative was developed that lowered the profile of Route 25 to the east of Fox Hollow Road. The option includes reconstruction of approximately 900' of roadway to lower the crest of the vertical curve approximately 2.5'. This would increase the sight distance to 500 feet and would meet the recommended Intersection Sight Distance criteria for a 45 mph roadway. Reconstruction of the roadway will require the re-establishment of slopes located on both sides of the roadway. The side slope on the north side of the road on the horizontal curve should also be regarded to improve the horizontal sight distance. This reconstruction of Route 25 will likely require construction easements from the 4 or 5 properties that abut Route 25. Utility poles that are located along the roadway in this area may need to be relocated. The reconstruction will require that the entire roadway surface, the existing base materials, and sub-base be removed. This process will require significant traffic control issues during the construction period on this busy arterial.

Alternative 10 – Construct New Alternative Roadway Connector

An alternative that has been discussed previously is the potential relocation of the Fox Hollow Road intersection easterly to the site of the former NHDOT Maintenance Facility (approximately 2000' east of the current intersection). A new Fox Hollow Road Connector, approximately 1150 feet long, would be constructed from Fox Hollow Road to Route 25 as shown on Figure 2. There is very good site distance on this section of Route 25 and the gradient on Route 25 is relatively level (about 1% compared to the 7% gradient at the existing intersection of Fox Hollow Road). There is currently a 50' roadway easement in this suggested alignment that was granted to some of the property owners along Fox Hollow Road and there is currently a gravel roadway/trail along the easement that connects Fox Hollow Road to the NHDOT property. The proposed roadway would utilize the basic alignment of this easement, but would be refined to provide an alignment to meet current Town roadway standards. Ground survey was obtained along the centerline of the easement in order to evaluate the vertical geometry of the proposed roadway. The potion of the easement that accesses Route 25 is only 17.5' as compared to the 50' width for the rest of the easement and would have to be widened to provide the connection to Route 25. Several issues should be considered for this relocation:

a. The existing easement will need to be "acquired" by the Town for use as a public way.
b. The roadway should be constructed to Town subdivision standards. This would require adjustments to the layout to provide acceptable roadway geometry.
c. The right-of-way at the approach to Route 25 would have to be increased from the existing 17.5 feet to 50 feet and would require additional right-of-way from either the NHDOT parcel or the parcel of land to the west of the proposed road.

d. Corner roundings for the intersection turning radii would also require additional right-of-way.
e. Slope easements beyond the limits of the right-of-way will likely be required.
f. There are wetlands adjacent to the roadway which would likely be disturbed be the construction. This would require permitting through the NHDES Dredge and Fill process.
g. Stormwater management facilities would be required to adequately treat and detain the surface run-off from the roadway
h. The existing section of Fox Hollow Road from Gilman Point Road to the new connector does not meet current Town roadway standards. It is a gravel surface, is too narrow to handle the increased traffic, and has several design deficiencies in the horizontal alignment and the profile. Reconstruction of the existing gravel road, including widening and improvements to both the horizontal and vertical alignments will be necessary.
i. With the improved access to Route 25 via the new connector, the existing intersection of Fox Hollow Road should be modified. The existing segment of Fox Hollow Road from Gilman Point Road to Route 25 could be removed entirely. Consideration could also be given to retaining the roadway and eliminating all left turns at the intersection. This would provide a limited secondary means of access for this area, while eliminating the problematic left turning movements at the existing intersection.

CONSTRUCTION COST ESTIMATE

The following table provides a construction cost estimate for Alternative 7 and 10 as previously described in this document. A copy of the construction estimates are included at the end of this Study. Please note that Alternative 10 has been divided into 2 segments: Fox Hollow Road Upgrade (Alternative 10a) and Fox Hollow Connector (Alternative 10b). The estimates are based upon current dollars and should be utilized for budgetary purposes only. Major construction items of each option and NHDOT unit prices for these items were utilized. Adjustment factors for miscellaneous items (drainage, mobilization, etc.) were added to the base price. In addition to the construction cost, there are several other items included in the total project cost. These items include the following:

Contingencies
These include miscellaneous items that can not be readily estimated at this time.

Design, Survey, Permitting
Upon completion of the Study, the final design of the project will need to be undertaken. The factor utilized in the estimate includes not only the engineering, but also topographical survey and preparation of environmental documents (i.e. permitting).

Construction Engineering
This is the cost associated with the resident engineer responsible for the oversight of the construction.

A summary of the total project cost per Alternative is as follows:

Alternative 7	$320,000
Alternative 10a	$120,000
Alternative 10a	$200,000
Alternative 10 (total)	$320,000

IV. Hearings

1. Dan & Dora Sabatino (117-16)(Gilman Point Road) Continued Five (5) Lot Subdivision

Mr. King noted that this was a continued hearing for Dan & Dora Sabatino. Present in the audience for this hearing was Brandon Giuda, Mark Sargent, Cindy Balcius, Doug Hill, Tony Puntin, Keith Nelson and Sharon Gulla.

Mr. King stated that the board had continued the hearing on October 24th to allow time for The Louis Berger Group to review the "Environmental Site Assessment" performed for the Sabatino property and to complete the engineering study and a cost analysis for the improvements of the intersection of Route 25 and Fox Hollow Road. The board also requested they provide the board with a list of alternative's that may be considered, which may include the relocation of the intersection to the area of the State's sheds.

Tony Puntin, P.E. was present for The Louis Berger Group, Inc. stating that he could only address the intersection, and did not realize that the environmental report was to be discussed this evening. Craig Wood, the professional wetlands scientist did send a memo to the board regarding the Environmental Site Assessment Review. Mr. Puntin noted that the engineering study was a multi-step process. The tasks completed since they received the contract was the review of the existing plans, including plans done in 1987 by Rist Frost, a state safety study conducted by Steve Pernaw, a T-square done by UNH, a report from Louis Caron, P.E. and they have been in contact with the NH DOT and the regional planning commission. The regional planning commission was able to provide Mr. Puntin with traffic data. In addition, from the Town Mr. Puntin was able to obtain the aerial mapping and the tax parcel information, which was very important to study the intersection.

Louis Berger Group has made three or four site visits at various times of the day looking in various directions. What they have found is that there's about 11,000 cars a day going past that intersection. It is an estimate based on ITE traffic numbers that there's 25 – 30 turning vehicles in a peak hour at that location. They conducted a left hand turn warrant analysis, and it was found out that the left hand turn lane, for traffic volume only, is not warranted. This does not take into account safety or site distance.

Louis Berger Group has contacted NH DOT and has set up a site visit for December 5th to go out with some local representatives of DOT. The tentative time is for 9 AM. Mr. Puntin feels that aside from the Town, DOT is the most important person to talk with, as anything that is done will affect the driveway permit or right of way in that area.

Mr. Puntin provided the board with a list of ten potential actions that could be taken. One of the objectives of this meeting was to put these options out on the table and it will then allow the board to discuss them and refine the list. These were 1. Install intersection warning signs 2. Lower posted speed limit. 3. Install flashing overhead beacon. 4. Improve sight distance to the east by re-grading the embankment on the southeast corner. 5. Construct westbound by-pass shoulder. 6. Construct left turn lane for westbound vehicles. 7. Improve sight distance by reconstructing and re-grading Route 25. 8. Relocate intersection to the west. 9. Relocate intersection to the east. 10. Construct new alternative roadway to intersect with Route 25 near the NHDOT maintenance facility. Mr. Puntin was seeking input from the board relative to the design alternatives to whittle the list to three or four. This would allow Mr. Puntin to proceed further in the process of calculating a cost estimate for the options chosen.

Mr. Puntin addressed each of the items with the board. After a lengthy discussion it was the feeling of the board that items 1-4 could be addressed, item 5 may pose an additional hazard for t-bone accidents, item 6 may be safer but does nothing to improve site distance, and items 8 & 9 would involve land taking.

The board directed Mr. Puntin to proceed with items 7 & 10. Mr. Puntin noted that they would only provide a cost estimate for the improvements described in items 7 & 10. The dollar figure for new construction is approximately $150 - $200 per foot. Most likely item 10 would be the most expensive of all the options. The board must take into consideration that Fox Hollow Road may need to be improved from the intersection of Gilman Point Road and Fox Hollow Road to the 50" ROW across the Davis property. This would be approximately 2300 feet of roadway.

Brandon Giuda, attorney representing Mr. Sabatino questioned if these decisions should be made by the Planning Board or the Board of Selectmen. Mr. Charest noted that this would need to be brought to the attention of the Board of Selectmen.

Doug Hill, attorney representing Keld Agnar stated that Mr. Agnar is intending to proceed with the relocation of the intersection near the NH DOT maintenance facility.

Mr. King noted that the Environmental Assessment Review was completed by The Louis Berger Group, noting that this is a very sensitive area and the primary concern is of Phase 2 for the additional five lots.

Mr. King questioned what the time frame would be to complete a cost analysis for items 7 & 10. Mr. Puntin noted that it could not be completed by the next meeting, and that the meeting of the 26th has been cancelled. He could have information available for the January 9, 2008 meeting.

Motion: Mr. Charest moved to continue the hearing for **Dan & Dora Sabatino (117-16)** to January 9, 2008.
Mrs. Coppinger Seconded.

Motion Carried – Unanimously.

The board took a five minute break from 8:55 – 9:00 PM.

2. <u>Sturgeon Family Revocable Trust (163-16)</u>(Sturgeon Lane)
Minor Two Lot Subdivision

Mr. King noted that this was a request for a minor two subdivision.

It was noted the Chief of Police had no comment.

It was noted that "As a 2 Lot Minor Subdivision the Fire Department has no objections to this application."

Dave Dolan agent for the Sturgeon Family Revocable Trust presented the application for subdivision. Mr. Dolan stated that both lots are fully developed. One is accessed off Sturgeon Lane and one off Hoyt Mill Road. Mr. Dolan noted that the applicant had received approval from the board in 1992 for a Second Dwelling on a Lot. It was noted that state subdivision is not required as the proposed lots are greater than five acres in size. There were no questions from the board.

Motion: Mr. Charest moved to approve the Minor Two Lot Subdivision for the **Sturgeon Family Revocable Trust (163-16).**
Mrs. Coppinger Seconded.

Motion Carried – Unanimously.

THE Louis Berger Group, INC.
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FOX HOLLOW ROAD

MOULTONBOROUGH, NH

LIST OF POTENTIAL ACTIONS

November 28, 2007

1. Install intersection warning signs
2. Lower posted speed limit
3. Install flashing overhead beacon
4. Improve sight distance to the east by re-grading the embankment on the southeast corner
5. Construct westbound by-pass shoulder
6. Construct left turn lane for westbound vehicles
7. Improve sight distance by reconstructing and re-grading Route 25
8. Relocate intersection to the west
9. Relocate intersection to the east
10. Construct new alternative roadway to intersect with Route 25 near the NHDOT maintenance facility

Fox Hollow Road Intersection Study

Cost Estimate Summary

Alternative 7 - Reconstruct Route 25

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Excavation/Fill	CY	3400	$10	$34,000
Pavement (6" thick, 28 wide)	TON	900	$75	$67,500
Subbase of Crushed Gravel (6" deep)	CY	500	$25	$12,500
Subbase of Gravel (12" deep)	CY	1000	$23	$23,000
Traffic control	LS	1	$20,000	$20,000
Landscaping (5%)	LS	1	$6,900	$6,900
Erosion Control (2%)	LS	1	$3,300	$3,300
Drainage (15%)	LS	1	$25,100	$25,100
Mobilization (8%)	LS	1	$15,400	$15,400

CONSTRUCTION SUBTOTAL =	$207,700
CONTINGENCIES (25%) =	$52,000
CONSTRUCTION TOTAL =	**$259,700**
DESIGN, SURVEY, PERMITTING (20%) =	$52,000
CONSTRUCTION ENGINEERING (4%) =	$10,000
PROJECT TOTAL (CURRENT YEAR) =	**$320,000**

NOTES:

Unit prices based upon NHDOT Average Price List

Right-of-Way costs are not included in the above estimate.

Excavation/Fill quantity estimated based upon observed existing topography.

Fox Hollow Road Intersection Study

Cost Estimate Summary

Alternative 10a - Fox Hollow Road Upgrade

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Excavation/Fill	CY	1000	$10	$10,000
Pavement (3" thick, 18' wide)	TON	550	$75	$41,250
Subbase of Crushed Gravel (3" deep)	CY	300	$25	$7,500
Subbase of Gravel (12" deep)	CY	0	$23	$0
Landscaping (5%)	LS	1	$2,900	$2,900
Erosion Control (2%)	LS	1	$1,200	$1,200
Drainage (15%)	LS	1	$9,400	$9,400
Mobilization (8%)	LS	1	$5,800	$5,800

CONSTRUCTION SUBTOTAL =	$78,050
CONTINGENCIES (25%) =	$20,000
CONSTRUCTION TOTAL =	**$98,050**
DESIGN, SURVEY, PERMITTING (20%) =	$20,000
CONSTRUCTION ENGINEERING (4%) =	$4,000
PROJECT TOTAL (CURRENT YEAR) =	**$120,000**

NOTES:

Unit prices based upon NHDOT Average Price List

Right-of-Way costs are not included in the above estimate.

Excavation/Fill quantity estimated based upon observed existing topography.

Fox Hollow Road Intersection Study

Cost Estimate Summary

Alternative 10b - Fox Hollow Connector

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Excavation/Fill	CY	2400	$10	$24,000
Pavement (3" thick, 22' wide)	TON	530	$75	$39,750
Subbase of Crushed Gravel (3" deep)	CY	300	$25	$7,500
Subbase of Gravel (12" deep)	CY	1200	$23	$27,600
Landscaping (5%)	LS	1	$4,900	$4,900
Erosion Control (2%)	LS	1	$2,100	$2,100
Drainage (15%)	LS	1	$15,900	$15,900
Mobilization (8%)	LS	1	$9,700	$9,700

CONSTRUCTION SUBTOTAL =	$131,450
CONTINGENCIES (25%) =	$33,000
CONSTRUCTION TOTAL =	**$164,450**
DESIGN, SURVEY, PERMITTING (20%) =	$33,000
CONSTRUCTION ENGINEERING (4%) =	$7,000
PROJECT TOTAL (CURRENT YEAR) =	**$200,000**

NOTES:

Unit prices based upon NHDOT Average Price List

Right-of-Way costs are not included in the above estimate.

Excavation/Fill quantity estimated based upon observed existing topography.